FLIGHT OF STS–5 WITH ASTRONAUTS COMDR. VANCE BRAND, COL. ROBERT OVERMYER, DR. WILLIAM LENOIR AND DR. JOSEPH ALLEN

HEARING

BEFORE THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

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FLIGHT OF STS-5 WITH ASTRONAUTS COMDR. VANCE BRAND, COL. ROBERT OVERMYER, DR. WILLIAM LENOIR AND DR. JOSEPH ALLEN

WEDNESDAY, DECEMBER 15, 1982

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C.

The committee met, pursuant to call, at 10:55 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the committee) presiding.

The CHAIRMAN. The committee will be in order.

Without objection, cameras and television will be allowed during the proceedings this morning.

The Science and Technology Committee is pleased to welcome the Associate Administrator for Space Transportation Systems, National Aeronautics and Space Administration, Lt. Gen. James Abrahamson, and the crew of the recently completed fifth flight of the space shuttle.

The flight crew for STS-5 was composed of Vance Brand, commander; Colonel Bob Overmyer, pilot; and mission specialists Dr. Bill Lenoir and Dr. Joseph Allen.

The fifth flight of the space shuttle marked the first operational use of the Nation's space transportation system. The space ship Columbia's first operational job was to place two commercial communication satellites into orbit.

The other significant firsts of this flight include the first flight with a crew of four astronauts, the first flight of mission specialists aboard the space shuttle. Gentlemen, it is our great pleasure to welcome you and to congratulate you on the completion of a very successful mission.

It should be mentioned that of the 36 mission objectives of the flight, 35 were completed in an outstanding manner. The only one remaining, as we all know, was the problem with the space suits. The failure to complete this last objective should in no way diminish the outstanding success of the mission. I am confident that this mission objective will be accomplished very soon.

We look forward to your report on the flight and take great pride in adding your names to the successful list of crewmen of the prior four flights. You did indeed contribute to America's technological leadership in space.

I would be remiss if I did not acknowledge the backup crew for this group, the four wives—Beverly Brand Katherine Overmyer, Bonnie Allen, and Elizabeth Lenior—for their courage and person-

al commitment during the years in which their husbands underwent intensive training. We salute you all.

We also have another special group with us this morning although it is not normal procedure. We would like to welcome Mrs. Teresa Purcell and her 6th grade class of very talented students from the Canterbury Woods School in Virginia. One of her student's father works on the committee, John Dugan, and that is also his name.

John, we are glad to have you and your fellow students here with us today.

First we will hear from General Abramson, but before that I would like to recognize the ranking minority member of the committee and a long-time supporter of the space program, Congressman Larry Winn from Kansas.

Mr. WINN. Thank you, Mr. Chairman.

I, too, want to welcome the astronauts and their wives. We appreciate having you appear before the committee today. I know there will be some questions, and I am sure that the rest of the members of the committee will want to give you their fair share of accolades because they, like all of us, agree that you guys have done a tremendous job.

Vance, Bob, Joe, and Bill, I want to add my congratulations to those of the chairman and look forward—I have a hunch that all of you fellows want to fly again, and I think some of you are already in line.

It is getting interesting. We have the various crews up here before the committee and already they are talking about flying again. I think that is the makeup of the beast and the program. That is great because even though we are training new astronauts all the time, you can't beat experience. Again, congratulations.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Winn.

I would like to at this time recognize the chairman of the Subcommittee on Space Science and Applications, Mr. Flippo.

Mr. FLIPPO. Thank you, Mr. Chairman. You and Mr. Winn covered the subject very well. I would add my congratulations, gentlemen. I know we are anxious to hear your report.

Thank you.

[The opening statement of Mr. Hollenbeck and the biographical sketches of the astronauts follow:]

OPENING STATEMENT HON. HAROLD C. HOLLENBECK—STS-5 ASTRONAUTS

Thank you, Mr. Chairman. I join with you and my colleagues on the Science and Technology Committee in welcoming the crewmembers from STS-5. Another "Hail Columbia" is certainly in order for Shuttle Commander Vance Brand, Pilot Robert Overmyer, and Mission Specialists Bill Lenoir and Joe Allen.

I would sum up the STS-5 mission as: perfect launch and landing. The solid rocket boosters, which sank last time, were recovered from the sea; and two revenue generating satellites were spun into space from the payload bay of the first operational orbiter. It's true—the Ace Trucking Company does deliver.

We have just started to pay back the American public for their investment in the reusable Space Transportation System: But, we often don't think about how far reaching this investment in faith extends. What is the real value for the scientific advances created by the space program? From rocketry to medicine, exotic metal alloys of incredible strength, synthetic fibers and materials, and our blossoming computer and communications business. There is no way to determine how much

space impacts our daily lives. In slightly over two decades we have seen room-sized, vacuum tube computers and land line limited communications systems make way for table top microcomputers and a multitude of space-based communications satellites. However, Mr. Chairman, we are just now on the tip of this technological iceberg. I wouldn't even guess where our space program will lead us to in the next 10 to 20 years; it is unfathomable.

In a few short weeks, I will be leaving my position in Congress and on this Committee. Before I leave, though, I would like to remind my colleagues of their responsibilities to NASA.

Our oversight activities in the past, have corrected many wrongful and hasty decisions by previous Administrations. In future years this oversight must become increasingly intensive.

I perceive a strong undercurrent of activity, on the current Administration's part, to marry NASA and the Department of Defense. This must not take place! These are two distinct agencies with two completely different roles. I realize that, at times, there are similar overlapping responsibilities, but each must retain its own separate identity. The civilian space agency serves a very important function to the scientific community, universities, and to all the American people. We cannot allow it to be overrun by the military.

I will continue to follow the course of NASA's space program and the oversight of this Committee. I only wish I could continue to guide the agency in my Congressional capacity; however, I will now begin my role as a very concerned citizen, and as a space advocate.

Finally, Mr. Chairman, congratulations are in order for these astronauts before our committee today, to the people at NASA, and also to the American people for completing yet another giant leap for mankind.

Thank you.

BIOGRAPHICAL DATA—VANCE DEVOE BRAND

Name: Vance DeVoe Brand (Mr.), NASA Astronaut.

Birthplace and Date: Born in Longmont, Colorado, May 9, 1931. His parents, Dr. and Mrs. Rudolph W. Brand, reside in Longmont.

Physical description: Blond hair, gray eyes; height: 5 feet 11 inches; weight: 175 pounds.

Education: Graduated from Longmont High School, Longmont, Colorado; received a bachelor of science degree in Business from the University of Colorado in 1953, a bachelor of science degree in Aeronautical Engineering from the University of Colorado in 1960, and a master's degree in Business Administration from the University of California at Los Angeles in 1964.

Marital status: Married to the former Beverly Ann Whitnel. Her parents, Mr. and Mrs. Otis W. Whitnel, reside in Houston, Texas.

Children: Susan N., April 30, 1954; Stephanie, August 6, 1955; Patrick R., March 22, 1958; Kevin S., December 1, 1963; and Erik R., May 11, 1981.

Recreational interests: Enjoys running to stay in condition, hiking, skiing, and canoeing.

Organizations: Fellow, American Astronautical Society; Associate Fellow, American Institute of Aeronautics and Astronautics, and the Society of Experimental Test Pilots; a Registered Professional Engineer in Texas; and member of Sigma Nu and Beta Gamma Sigma.

Special honors: JSC Certificate of Commendation (1970), the NASA Exceptional Service Medal (1974), the NASA Distinguished Service Medal (1975); Zeta Beta Tau's Richard Gottheil Medal (1975); the Wright Brothers International Manned Space Flight Award (1975); the Veterans of Foreign Wars National Space Award (1976); the Sigma Nu Distinguished Alumnus of the Year Award (1976); the Federation Aeronautique Internationale's Yuri Gagarin Gold Medal (1976); University of Colorado Alumnus of the Century (1 of 12) (1976); the AIAA Special Presidential Citation (1977); the American Astronautical Society's Flight Achievement Award for 1976 (1977); the AIAA Haley Astronautics Award for 1978 (1978); the JSC Special Achievement Award (1978).

Experience: Military—Commissioned officer and naval aviator with the U.S. Marine Corps from 1953 to 1957. Military assignments included a 15-month tour in Japan as a jet fighter pilot. Following release from active duty, Brand continued in Marine Corps Reserve and Air National Guard jet fighter squadrons until 1964.

Civilian—Employed as a civilian by the Lockheed Aircraft Corporation from 1960 to 1966, working initially as a flight test engineer on the P3A Orion aircraft. In

1963, Brand graduated from the U.S. Naval Test Pilot School and was assigned to Palmdale, California, as an experimental test pilot on Canadian and German F-104 development programs. Immediately prior to selection to the astronaut program, Brand worked at the West German F-104G Flight Test Center at Istres, France, as an experimental test piolt and leader of a Lockheed flight test advisory group.

Flight experience: 6,950 flying hours, which includes more than 5,900 hours in jets and 390 hours in helicopters, and checkout in more than 30 types of military aircraft.

NASA experience: One of the 19 pilot astronauts selected by NASA in April 1966, Brand first served as a crew member of the thermal vacuum chamber testing of the prototype command module and was a support crewman for the Apollo 8 and 13 missions. Later he was backup command module pilot for Apollo 15 and backup commander for the Skylab 3 and 4 missions.

Vance Brand launched on his first space flight on July 15, 1975, as Apollo command module pilot on the Apollo-Soyuz Test Project (ASTP) mission. This joint space flight resulted in the first historic meeting in space between American astronauts and Soviet cosmonauts. Other crewmen taking part in this 9-day earth-orbital mission were Thomas P. Stafford (Apollo commander), Donald K. Slayton (Apollo docking module pilot), cosmonaut Alexey Leonov (Soyuz commander) and cosmonaut Valeriy Kubasov (Soyuz flight engineer). The Soyuz spacecraft was launched at the Baikonur Cosmodrome in Central Asia, and the Apollo was launched 7½ hours later at Cape Canaveral. Two days later the Apollo spacecraft accomplished a successful rendezvous and docking with Soyuz. The linkup tested a unique, new docking system and paved the way for future international cooperation in space. Twenty-eight experiments were performed during the flight. There were 44 hours of docked joint activities which included four crew transfers between the Apollo and the Soyuz. All major ASTP objectives were accomplished, and experience was gained in the conduct of complex, international manned missions. Six records for docked and group flight were set on the mission and are recognized by the Federation Aeronautique Internationale. Apollo splashed down in the Pacific Ocean near Hawaii, less than a mile from the targeted splash point, and was promptly recovered by the USS *New Orleans*. Brand logged 217 hours on his first space flight.

Mr. Brand was the commander of the first operational Space Shuttle mission (STS-5). Mr. Brand, with fellow astronauts Robert Overmyer as the pilot and mission specialist Drs. Joseph P. Allen and William B. Lenoir aboard, were launched in the orbiter *Columbia* from the John F. Kennedy Space Center at 7:19 a.m. EST on November 11, 1982. During the five day mission two communication satellites were deployed by Drs. Allen and Lenoir. The *Columbia* landed on a hard runway at Edwards Air Force Base in California at 9:33 a.m. EST on November 16.

Biographical Data—Robert F. Overmyer

Name: Robert F. Overmyer (Colonel, USMC) NASA Astronaut

Birthplace and date: Born July 14, 1936, in Lorain, Ohio, but considers Westlake, Ohio, his hometown.

Physical description: Brown hair; blue eyes; height: 5 feet 11¾ inches; weight: 180 pounds.

Education: Attended and graduated from Westlake High School, Westlake, Ohio, in 1954. Received a bachelor of science degree in Physics from Baldwin Wallace College in 1958. Received a master of science degree in Aeronautics with a major in Aeronautical Engineering from the U.S. Naval Postgraduate School in 1964.

Marital status: Married to the former Katherine E. Jones of Mount Lebanon, Pennsylvania. Her parents, Mr. and Mrs. Henry R. Jones, now reside in Highland Beach, Florida.

Children: Carolyn Marie, 1966; Patricia Ann, 1968; Robert Rolandus, 1970.

Recreational interests: Include skiing, water skiing, boating, acrobatic flying in open cockpit biplanes, coaching baseball, and running.

Organizations: Member of the Society of Experimental Test Pilots, Member of Experimental Aircraft Association, and Member of Aircraft Owners and Pilots Association.

Special honors: Awarded the USAF Meritorious Service Medal in 1969 for duties with the USAF Manned Orbiting Laboratory Program; awarded the USMC Meritorious Service Medal in 1978 for duties as the Chief Chase Pilot and support crewman for the Shuttle Approach and Landing Test Program.

Experience: Colonel Overmyer entered active duty with the Marine Corps in January 1958. After completing Navy flight training in Kingsville, Texas, he was assigned to Marine Attack Squadron 214 in November of 1959. Colonel Overmyer was

assigned to the Naval Postgraduate School in 1962 to study aeronautical engineering. Upon completion of his graduate studies, he served 1 year with Marine Maintenance Squadron 17 in Iwakuni, Japan. He was then assigned to the Air Force Test Pilots School at Edwards Air Force Base, California. Colonel Overmyer was chosen as an astronaut for the USAF Manned Orbiting Laboratory Program in 1966. The program was cancelled in 1969. Colonel Overmyer has over 6,000 flight hours with over 4,500 in jet aircraft.

NASA experience: He was selected as a NASA astronaut in 1969 after the MOL Program was cancelled. His first assignment with NASA was engineering development duties on the Skylab Program from 1969 until November 1971. From November 1971 until December 1972, he was a support crew member for Apollo 17 and was the launch capsule communicator. From January 1973 until July 1975, he was a support crew member for the Apollo-Soyuz Test Project and was the NASA capsule communicator in the mission control center in Moscow, USSR. In 1976, he was assigned duties on the Space Shuttle Approach and Landing Test (ALT) Program and was the prime T-38 chase pilot for orbiter Free-Flights 1 and 3.

Colonel Overmyer made his first spaceflight aboard the *Columbia* as pilot of the first operational Space Shuttle mission (STS-5). The commander was Vance D. Brand and the crew included two mission specialists, Drs. Joseph P. Allen and William B. Lenoir. Two communications satellites were deployed by Allen and Lenoir during 5 days in space. Overmyer and his fellow astronauts were launched from the John F. Kennedy Space Center at 7:19 a.m. EST on November 11, 1982. Landing occurred on November 16, at 9:33 a.m. EST after 122 hours and 14 minutes in space.

Biographical Data—William B. Lenoir

Name: William B. Lenoir (PhD) NASA Astronaut

Birthplace and date: Born on March 14, 1939, in Miami, Florida. His father, Mr. Samuel S. Lenoir, resides in Miami.

Physical description: Brown hair; brown eyes; height: 5 feet 10 inches; weight: 150 pounds.

Education: Attended primary and secondary schools in Coral Gables, Florida, is a graduate of the Massachusetts Institute of Technology where he received a bachelor of science degree in Electrical Engineering in 1961, a master of science in 1962, and a doctorate in 1965.

Marital status: Married to the former Elizabeth May Frost. Her mother, Mr. Thomas F. Frost, resides in Brookline, Massachusetts.

Children: William B., Jr., April 6, 1965; Samantha E., March 20, 1968.

Recreational interests: His hobbies include sailing, woodworking, and outdoor activities.

Organizations: Senior member of the Institute of Electrical and Electronics Engineers; and member of Eta Kappa Nu, and the Society of Sigma Xi.

Special honors: A Sloan Scholar at the Massachusetts Institute of Technology and winner of the Carleton E. Tucker Award for Teaching Excellence at MIT; awarded the NASA Exceptional Service Medal (1974).

Experience: From 1964 to 1965, Lenoir was an instructor at MIT; and in 1965, he was named assistant professor of Electrical Engineering. His work at MIT included teaching electromagnetic theory and systems theory and performing research in the remote sensing of planetary atmospheres and surfaces and the theory of radiative transfer in anisotropic media.

He has been an investigator in several satellite experiments and continues research in this area while completing his astronaut assignments.

Lenoir is a registered professional engineer in Texas.

He has logged over 2,900 hours of flying time in jet aircraft.

NASA experience: Dr. Lenoir was selected as a scientist-astronaut by NASA in August 1967. He completed the initial academic training and a 53-week course in flight training at Laughlin Air Force Base, Texas.

Lenoir was backup science-pilot for Skylab 3 and Skylab 4, the second and third manned missions in the Skylab Program. During Skylab 4, he was co-leader of the visual observations project and coordinator between the flight crew and the principal investigators for apollo telescope mount solar science matters.

From September 1974 to July 1976, Lenoir spent approximately one-half of his time as leader of the NASA Satellite Power Team. This team was formed to investigate the potential of large-scale satellite power systems for terrestrial utility consumption and to make program recommendations to NASA Headquarters.

Lenoir has supported the space shuttle program in the areas of payload deployment and retrieval. His interest in the remote sensing of the earth and its resources continues, with particular emphasis on the role of man.

Dr. Lenoir was a mission specialist on the first operational flight of the Space Shuttle (STS–5) which was launched from the John F. Kennedy Space Center in Florida on November 11, 1982 at 7:19 a.m. EST. During the mission of 122 hours and 14 minutes in space, he and fellow mission specialist Dr. Joseph P. Allen deployed two communications satellites from the cargo bay of the orbiter *Columbia.* A scheduled extravehicular activity (EVA) by Drs. Lenoir and Allen was cancelled because of malfunctioning space suits. Their spaceship the *Columbia*, with commander Vance Brand and pilot Robert Overmyer at the controls, landed on a hard runway at Edwards Air Force Base in California at 9:33 a.m. EST on November 16.

Biographical Data—Joseph P. Allen

Name: Joseph P. Allen (Ph. D.), NASA Astronaut.

Birthplace and date: Born in Crawfordsville, Indiana, on June 27, 1937. His parents, Mr. and Mrs. Joseph P. Allen III, reside in Greencastle, Ind.

Physical description: Brown hair; blue eyes; height: 5 feet 6 inches; weight: 125 pounds.

Education: Attended Mills School and is a graduate of Crawfordsville High School in Indiana; received a bachelor of arts degree in Math-Physics from DePauw University in 1959 and a master of science degree and a doctorate in Physics from Yale University in 1961 and 1965, respectively.

Marital status: Married to the former Bonnie Jo Darling of Elkhart, Ind. Her mother, Mrs. W. C. Darling, resides in Elkhart.

Children: David Christopher, September 1968; Elizabeth Darling, May 1972.

Recreational interests: His hobbies include handball, squash, flying, sailing, skiing, music, and photography.

Organizations: Member of the American Physical Society, the American Astronautical Society, the American Institute of Aeronautics and Astronautics, the American Association for the Advancement of Science, the American Astronautical Society, Phi Beta Kappa, Beta Theta Pi, Sigma Xi, and Phi Eta Sigma.

Special honors: Winner of a Fulbright Scholarship to Germany (1959–1960), the Outstanding Flying Award, Class 69–06, Vance Air Force Base (1969), two NASA Group Achievement Awards (1971 and 1974) in recognition of contributions to the Apollo 15 Lunar Traverse Planning Team and for subsequent work on the Outlook for Space Study Team; presented the 1972 Yale Science and Engineering Association Award for Advancement of Basic and Applied Science, the DePauw University Distinguished Alumnus Award (1972), a NASA Exceptional Scientific Achievement Medal (1973), a NASA Exceptional Service Medal (1978), and a NASA Superior Performance Award (1975 and 1981).

Experience: Allen was a research associate in the Nuclear Physics Laboratory at the University of Washington prior to his selection as an astronaut. He was a staff physicist at the Nuclear Structure Lab at Yale University in 1965 and 1966 and, during the period 1963 to 1967, served as a guest research associate at the Brookhaven National Laboratory.

He has logged more than 2,800 hours flying time in jet aircraft.

NASA experience: Dr. Allen was selected as a scientist-astronaut by NASA in August 1967. He completed flight training at Vance Air Force Base, Oklahoma. He served as mission scientist while a member of the astronaut support crew for Apollo 15 and served also as a staff consultant on science and technology to the President's Council on International Economic Policy.

From August 1975 to 1978, Dr. Allen served as NASA Assistant Administrator for Legislative Affairs in Washington, D.C. Returning to the Johnson Space Center in 1978 as a senior scientist astronaut, Dr. Allen was assigned to the operations mission development group. He served as a support crew member for the first orbital flight test of the space transportation system and was the entry CAPCOM for this mission. In addition, in 1980 and 1981, he worked as the technical assistant to the Director of Flight Operations.

Dr. Allen was a mission specialist on the first operational flight of the Space Shuttle (STS–5) which was launched from the John F. Kennedy Space Center in Florida on November 11, 1982 at 7:19 a.m. EST. During the mission of 122 hours and 14 minutes in space, he and fellow mission specialist Dr. William B. Lenoir deployed two communications satellites from the cargo bay of the orbiter *Columbia.* A scheduled extravehicular activity (EVA) by Drs. Lenoir and Allen was cancelled because of malfunctioning space suits. Their spaceship the *Columbia,* with commander

Vance Brand and pilot Robert Overmyer at the controls, landed on a hard runway at Edwards Air Force Base in California at 9:33 a.m. EST on November 16.

The CHAIRMAN. With that, General Abrahamson, we would be pleased to hear from you and the crew.

STATEMENT OF LT. GEN. JAMES A. ABRAHAMSON, ASSOCIATE ADMINISTRATOR FOR SPACE TRANSPORTATION SYSTEMS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

General ABRAHAMSON. Thank you, sir. I will be very brief this morning.

Sometimes our communications technology is not at a level that we can wish and are able to do.

Mr. Chairman and members of the committee, we at NASA are particularly pleased for the support that this committee and the Congress has offered to the space program throughout the many years that the Space Shuttle has been in a development period.

The development of the Space Shuttle was a national endeavor, lasting over a decade. This particular flight represents the point in time where all of that effort by so many people has now begun to pay off in a very major way for this Nation, a way that we think leads to a period where the United States will continue its leadership in space and truly be a spacefaring nation for the eighties and the nineties. We think this is a very important element the way of the U.S. future.

The importance of this particular mission as the first operational flight was well-known to everybody. I would underscore, however, that even though it was the first operations flight, it occurred successfully even though we have only had four test flights of the vehicle.

That means that there is additional development work that will be ongoing as we go ahead. Nonetheless, we still feel confidence in the vehicle and the team, so that we can go into the operational phase of the Space Shuttle program, meet our mission objectives, and continue to do some of the test effort that is required.

It was a very great milestone, and it was led by this crew, of which the Agency and I believe the Nation is so very, very proud. This crew, in fact, is the "We Deliver" crew. That is their phrase. It is now the important way in which we characterize the beginning of the operational phase.

So, without going into more detail, I would like to ask Vance, as the commander of this crew, and the commander of this effort, to put the overall mission in perspective.

I would like to make one comment about the space suit issue. It was a development objective that was tagged on fairly late in the program. Even though we were not able to proceed at this time, we did get very important information in order to correct problems so that we can quickly go in and make the extra vehicular activity the operating part of the program that we think it should be.

Therefore, we did get a great deal from even the failure and the lack of being able to go out on the extra-vehicular (EVA) situation. What we got from this particular effort was an understanding of where we need to correct it. We have made several of those correc-

tions. We will also be able to proceed into that next part of the program.

As a development objective, we do not feel that it detracted from the flight. The real mission was the one that was to get the mission off on time and to deliver the space craft, and that is what they did.

I would like to ask Commander Brand, please, if you would give us your view of this particular mission. I am sure the committee would like to understand what you feel this mission implies for the future of the Space Shuttle program and the Nation.

STATEMENTS OF VANCE BRAND, COMMANDER, STS-5; ROBERT OVERMYER, COLONEL, U.S. MARINE CORPS, STS-5 PILOT; JOSEPH P. ALLEN, STS-5 MISSION SPECIALIST; AND WILLIAM B. LENOIR, STS-5 MISSION SPECIALIST

Commander BRAND. Thank you, General Abrahamson.

Mr. Chairman, members of the committee, it is a real pleasure for us to be here today. Thank you very much for inviting us to this hearing, and inviting our wives, too. We felt very fortunate to be assigned to this mission, the first operational mission. We were the most visible part of NASA for a short time, but we felt that we were fortunate, since we represented everyone else that was behind us in this effort. To a large extent, we represented them during this time when we were on orbit. We enjoyed the visibility which many others deserved, probably more than we did. We were representatives of the American people.

I think coming in here yesterday on an airliner, it was sort of fun to think, well, here we are at 6 miles of altitude and only 1 month ago it was 160. Here we are traveling about 500 or 600 miles an hour, and 1 month ago it was 4 miles a second, which is mind-boggling.

We are just really pleased as a crew that we had the good fortune and everything behind us that made this mission go well. Personally, I was surprised that a deployment system would work so well—actually, flawlessly—the first time it was tried. That is very unusual. The vehicle was superb. The vehicle is a national resource. On our mission we were very conscious of that fact. I believe every crew that follows us will be, too.

I think, though, in summary that our success is a tribute to the thousands of people in the program, the companies, the Government agencies, such as NASA, the Defense Department, and others that were involved.

It is especially a tribute to your patience here in the Congress and this committee, to your backing through the years, through the hard times. Now we are enjoying a lot of success, having pulled off the first operational mission. There will be many more deployments similar to ours. We have, in a sense, driven the golden spike on this transportation system.

I don't suspect that it will always be easy in the future. As you well know, it is a lot harder to accomplish one of these missions than it appears to on television. I am sure patience will be needed in the future because operating in space is still very demanding.

We have a tremendous capability for the future. We are the 'We Deliver' crew, but we feel that NASA and those behind us delivered.

With that, we would like to show our travelogue. We have a few slides, but first a movie. We will start out with the movie so you can see how it was up there.

Bob will start out with the movie. [Movie shown]

Colonel OVERMYER. Mr. Chairman, as all launches do, we started out at Pad 39 at the Cape on a very spectacular day provided by the good State of Florida. We could not have had a clearer day, as those of you who were at the launch knew. It was just superb.

When I was sitting there that morning, as we were waiting for ignition looking out and seeing there were no clouds, I just knew it was going to be very, very impressive. At about this time I think Joe, Bill, and I were looking and thinking well, there is no turning back now, we are going one way or another.

The ride uphill was extremely interesting. We had had some different winds than had been predicted, and it was possibly a little rougher than we had thought, but it obviously was not too rough on the payloads, as they are now performing so flawlessly in space. The roll program and pitch as we go on down range is just a tremendous feeling. Again, we could occasionally sneak a peak outside, but most of the time we were all on our gauges, watching the performance of the vehicle.

I would emphasize that the whole system just performed flawlessly during this ascent phase. It was a tremendous experience. We got up to about 27 miles pretty quick, since we weigh only about 4 million pounds and we have got 7 million pounds of thrust. It is pretty spectacular.

These are some of the best pictures ever taken of the separation sequence as the solid rocket booster (SRB) separate. We are very, very proud of the people at Huntsville in particular, the lead center on the SRB's, to get these shots here, as we see the boosters fall away burned out. There are just the final extinguishing flames on them. Pretty soon we are going to see the parachutes deploy, which are so important for recovery. This is one of the best pictures you will ever see of this particular sequence, the drogue chutes being pulled out and descent. They will go through the cloud deck and then impact on the water. We are happy to report that they were retrieved and brought back into port and will be refurbished for reuse in one of the missions downstream.

This is quite a spectacular sight here. The one SRB is already in the water. These will impact shortly. They just came down that close to each other and very close to the target point, I guess again proof to everybody concerned that we are in fact retrieving these boosters.

Meanwhile, they really didn't forget us. We were continuing to proceed on uphill to an outstanding ride. It became extremely smooth after we got on the second stage. It was just like being driven in a luxury car. There was absolutely no movement at all. The main tank moved away, and then Vance gave us 11 seconds of plus-X forward thrusting so that we could go ahead and take these pictures from our belly camera, to the cameras that are mounted in the well there with the internal tank door. You can see the

tank, you can see some of the ice formation on it, some spectacular photography here for engineering analysis later.

Shortly after we were on orbit we went to work. At this point we are busy getting ready for our ohms one and ohms two to give us our circular 160 nautical mile orbit, which we ultimately achieved. This sight, of course, is one that never pales and we just were always fascinated, the wonderful world below us and the black of space. Shortly after orbit and after achieving the 160 nautical mile orbit, we had to open up our payload bay doors so that we could remain on orbit and turn out our flash evaporator system and get on radiator cooling. This is an important step. When it opened flawlessly, we were really pleased because this makes life a lot easier when you are up there. The urgency then goes away the whole time you are in orbit after that because the doors are open and you have plenty of time to worry about the other problems.

This has been talked about among the public as our PacMan. PacMan is swallowing up the satellite business systems (SBS) satellite here. I believe Bill will go ahead and cover the sequences concerning the satellite deployment coming up.

Dr. LENOIR. In this, what we had to do just after getting to orbit was to close the Sun shield over the top of the two satellites to protect them from the Sun until such time as we were going to deploy them.

This is taken of Joe and Bob looking in the middle, and Vance here on the right during the spin-up sequence of the SBS satellite. I am up at the front working. They wouldn't let me look out the back. This is the beginning of that sequence, what we call mechanical sequence, where we open up the sun shield on the SBS satellite. Shortly after the sun shield is fully opened, to permit it to come out, we begin the spinning of it, which is the sole means it has for stabilization until it actually begins its solid rocket burn 45 minutes after we deploy it. This is driven by a motor on a spin table that stays with the Orbiter. It will get used again on a subsequent flight. It is now spinning at 50 revolutions per minute, and it has just been released. We hear a loud bang and we feel it through the Orbiter, but the spacecraft doesn't feel it and there is no evidence that anything has happened if you are watching the space craft, other than it starts up.

It is really quite a sight to see. We understand a lot of people on the ground were accusing us of animation and because of the contrast of it, it looked a little bit that way to us. You can see it right here. We could see it miles away with the naked eye until such time as we maneuvered the spacecraft to put our belly toward it.

This is me. Joe has taped me down to the mid-deck floor here. We are performing a medical experiment. Joe has the magic box here that has all the cables and the dials on it. I have got the sensors on my head here that are trying to sense the position of my eyes and the response of that whole nervous system to various movements of my head and eyes.

Vance is on the treadmill here for exercise. Notice one of our tissue kits is just floating freely. It is not tied down to anything, just sort of floating freely.

Bob, do you want to talk about this one? Bob is eating here. [Laughter.]

Colonel OVERMYER. One of the interesting things we looked at a great deal during the mission was to review the capability of the Shuttle to support four men and looking downstream to support five- and six-man crews and how well we will live. We made quite a lengthy study of the habitability and will be reporting on it at great length throughout all the publications.

Again, Bill got a reward for doing good work that day. Joe has discovered a new way to eat. We don't recommend this to any of the youngsters in the audience, but coming up Joe is going to demonstrate the proper way to eat space food and study the dynamics of physics while you are at it.

He has released the spoon——

Dr. LENOIR. Fruit cocktail in syrup is on that spoon. [Laughter.]

Colonel OVERMYER. He has got it. He spilled a couple drops. Watch him get the drops. He has got two of them going. He has to get them. We have to have a clean spacecraft. He has them both. [Laughter.] I am just so busy out there cooking that we didn't have much time to do anything else.

This is Vance's slow roll in space. Every good pilot likes to roll an airplane, and regardless of how big they are you still like to roll them. Some have rolled 747's and other aircraft.

Here is the Orbiter in a roll with the Earth down below. Actually, sir, this is a test of the antenna system as we pass over the United States, but it was fun to accomplish. Notice the sunlight coming up very bright on the starboard side of the vehicle and showing the stark contrast between the black shadows and the bright sunlight. A spectacular sight we never got tired of looking at.

I think the whole time Vance was rolling; Joe and I were at the back windows just looking at that horizon go by. Joe captured many, many inches of film on this. Not a particularly high-speed roll, but pretty good for a large vehicle.

Bill?

Dr. LENOIR. That was just Joe and me prior to the Telesat deploy. This sequence is taken from a television camera that was on the aft bulkhead looking forward. This is the Satellite Business Systems sun shield closed here. This is coming out of the cradle behind this one, going on out. This was on day two, looked very much like the first one, as we deployed it spinning at 50 revolutions per minute.

Again, you can see it here spinning as it goes away from us or we go away from it. It is kind of hard to tell when you are in zero gravity. It depends on who you are and which way you think.

This was on the evening of day three in orbit. This is Joe, I am in the air lock here, and we are getting ready at this time for the space walk which was at that time to be done the next morning, on day four. Subsequently, we postponed it until day five.

This is the television camera that was to go on Joe's helmet. This down here, that has just floated out of the way, are the lights that go on each of our helmets.

Colonel OVERMYER. I might add here that Vance and I had been working on the flight deck and we came on down and pointed out that the camera was on, the little red light was on, and just like youngsters everywhere, once the light is on you can't help but do a

little clowning. You will have to forgive us. We actually did do some work I can assure you occasionally, but this time we just came down and had a little fun on the flight deck.

We never got tired of the feeling of zero gravity and the fun that it is, and I hope that some day we can take one of you along so that you can experience it with us because it is quite a thrill. There is no question about it.

Actually, you might think that I am upside down in this picture, or Vance just got upside down, but I think we would vote that Joe and Bill were probably in the wrong directions. Quite frankly, there is no feeling of up or down when you are there.

As you can see, it was crowded at times, but even just fooling around we had plenty of room to operate and maneuver. We had no difficulty with the four-man crew.

Dr. LENOIR. Bob just dropped his pencil. Watch it float. He is going to reach and miss it and Joe will get it for him. It is just floating around.

Colonel OVERMYER. The ground had called, so Vance went back up topside, and I guess I better be moving up there, too.

Dr. ALLEN. Mr. Chairman, this is an experiment put aboard by NASA to be done actually for students, high school students, when the experiment was proposed, a very interesting experiment to study how fluids move when heated under zero gravity.

This is kind of a living picture aboard *Columbia* in the middeck. Vance is on the treadmill, his daily exercise, and Bob is about to go upstairs to the flight deck with a surveying instrument to make sure that the payload bay doors are not warping and still working correctly. I am preparing a camera to go outside on the next day. We didn't get completely outside on the next day, as you know, sir. However, Bill is suited here in the winter space suit. The summer space suit is shown on the right. Bill is in the airlock in a slightly depressurized condition, doing some checkout on the suits. This was part of the troubleshooting procedure that we followed. He looks to be upside down, it's upside down with respect to the camera. His feet are in a holding device at the top of the airlock, and he is literally suspended in his suit as he goes through different maneuvers and checkout procedures.

Dr. LENOIR. I might point out that somebody thought I was right side up, because look at the two there.

Dr. ALLEN. This picture was taken through a small peephole in the airlock. We voted, should we look at what Bill was doing or permit the camera to? The camera won, probably good, because we can all see that picture now.

Colonel OVERMYER. All good things must come to an end. We had to open up the sun shields to permit us to close the doors with our radiators on them, the primary sources of course being the radiators.

Quite frankly, we were very, very pleased when the doors closed without a hitch and we had no sign of the warpage or any difficulties that had been experienced previously after the long duration times at very thermal attitudes. We had kept a benign attitude the last day or so. The vehicle had not warped, as we had predicted it would not, and our doors closed without any problem. So I think we can pretty well put away the issue of the doors getting stuck, as

happened on flights 3 and 4, and write it off as a thermal expansion warpage problem.

If you keep a decent attitude, we will probably never have that difficulty. Since those attitudes were always associated with a very severe attitude that is not necessarily a requirement for operational use, we are confident now that the door system on *Columbia* is absolutely as advertised and works just according to specification.

Shortly after this door sequence comes there is a most spectacular shot that we were fortunate enough that Joe had gotten by putting up a camera during reentry. As you know, we had deorbit burns somewhere over the Indian Ocean and we were in dark for the vast majority of our flight.

If you will notice the windows right there that Bill is pointing at, those will start glowing. Pretty soon they were rust colored, they turn to a pink color, then they were a bright orange color. This was the glow of entry. It could be disconcerting at times, as we sat there and watched it develop around the spacecraft. This stayed with us from entry mach, about mach 24, until about mach 10, when we broke out into some sunlight and it went away. That has never been captured before, that glow of reentry. You know you are inside of a blast furnace when you come down looking at that. It is quite an interesting show.

That is Vance's helmet and the switch guard is up above us.

Vance, why don't you take this one?

Commander BRAND. After traveling for a very long distance over the Pacific Ocean we arrived close in to Edwards Air Force Base, went into a few clouds, 2,000 or 3,000 feet at least, popped out and we were on final for the concrete runway at Edwards.

Here we are on the steep glide slope, as we call it, coming down rather fast, about 285 knots, with the reflection of the Sun on the back. Here we see it from the ground camera.

The vehicle I thought handled very well. I had the opportunity to fly it manually in the subsonic regime. That gave me a lot of opportunity to get used to it before we got this low, actually.

Here we are pulling out of this rather steep glide on to a shallow, sort of airline-type trajectory now. The landing gear is coming down. Bob put it down at 400 feet. Joe called out when he saw it down. We are crossing over the threshold and onto the runway.

It was nice to see that we were home, although it was a lot of fun to be up there, too.

Dr. LENOIR. Vance would never say this, so I will. I came in on the middeck and just after we had touched with the main gear. I really had to ask, because I couldn't feel us land.

Commander BRAND. We got the nose gear down, had a max braking test, which meant literally standing on the brakes as hard as we could. We did that from a speed of 140 to 80 knots, then let off on the brakes and came slowly to a stop.

It is a very nice thing to land around sunrise. The air is calm, we had adequate lighting. After stopping, an armada of trucks approached us. We almost felt like getting up and running because there was really a lot of activity around us.

When it came time to get out, about a half hour later, we adapted very easily back to the status of having weight.

So much for that one.

Thank you very much. With your permission, Mr. Chairman we have a few slides and a couple of remarks and that will complete our travelog.

Bill, why don't you start out?

Dr. LENOIR. I understand the doors have just been locked. We have 2,000 pictures that we took on our recent trip we would like to show you. [Laughter.] As Vance said, we are not going to show quite all of them. I think we held 10 of them out.

Dr. ALLEN. Mr. Chairman, we wanted to start with this. [Slide.]

This was when you and Mr. Winn appeared before us, our committee of four, Cape Kennedy. This was the day before launch day. We certainly appreciated your being there. This was I guess one of the NASA photographers that took this.

Colonel OVERMYER. Of course, we appreciated your wives being there even more. That added a lot of color to life.

Dr. LENOIR. What we have are quite a few slides that we wanted to show you. Our intent is not so much to pass on technical information as it is to try to do the best that we can to share our experiences and to make each and every one of you feel as though you had been aboard with us, so that we will have some of the technical, some of the habitability, some of the just general living in space. [Slide.]

Dr. ALLEN. This is what we saw as a crew, as we went up in the elevator, got out of the elevator, and there is the beautiful Columbia with the searchlights on her, the solid rockets and the external tank, and we walk across the walkway on the right to get into the vehicle. [Slide.]

The patch of the "We Deliver" crew and the delivery is shown right there in the top point of the star. [Slide.]

Dr. LENOIR. Just to start off here, we wanted to show--I think each of these is going to need some focusing. I am not sure how we managed to take all these in a different focus scheme. This also doubles as an astronaut eye test on our annual physical. [Laughter.]

As you can see here, this is the still picture that is the SBS satellite. Joe said, the PacMan here is open and the satellite is actually caught; it is in the process of rotating at 50 revolutions per minute on its way out, making history, being the first satellite deployed from the Space Shuttle.

One of the interesting sidelights that we learned after the mission, talking with the Satellite Business people, there are many, many communications satellites in orbit, and it really didn't sink into them until afterward when the Comsat people, who are one of the parent organizations, saw the videotapes of the deployments and realized that nobody in that whole industry has ever seen his satellite in orbit. That was a new first, and they were just fascinated watching that. [Slide.]

Equal time here. This is the Telesat, as we showed in the movie, that was deployed from behind the sun shields. [Slide.]

The next slide shows it again as it is receding away from us. It makes you a little bit nervous the first time you realize you are looking right up the engine bell of a solid rocket, but sure enough the timer and all of its systems worked out just fine and 45 minutes after we deployed it, when we were a safe distance away, its

rocket engine ignited to send it on its way to the higher geosynchronous orbit.

One of the fascinating things about being in orbit is the Earth really is curved. You can see the sunlit Earth here, and on the day side of the orbit there is nothing as black as the black sky above the Earth. [Slide.]

This is a picture that Joe took. It is the ignition part of an ohms burn, the orbit maneuvering system that was used to separate us from the PAM.

This is one shot in a sequence of about a dozen, and it is the only one that the glow from the burn appears in. It lasts for about a fifth of a second, as the burn gets stabilized, and it is the first time that we have been able to capture it here.

Joe took an awful lot of good pictures for us. You notice the wing back here, the tail, of course, and the other wing on this side. [Slide.]

This was Vance and me. We were just shaking hands. It is probably not clear what we were doing. We must have been getting ready for the Telesat deploy on the second day. [Slide.]

This is Joe. Most of us just tended to take our little drink containers, stick the straw in it and drink. Joe, being a physicist, decided he was going to do it differently. He got a batch of orange juice here—Florida orange juice, I am sure—and took it out and just let it be free. So there is a sphere of orange juice floating free in zero gravity. He then took the straw and stuck it in the orange juice ball and managed to consume it that way. That was such a difficult task, he was so beside himself when he finished—[slide]—that he just couldn't believe he had done such a thing. Actually, what he said was he couldn't believe he ate the whole thing. [Laughter.] [Slide.]

This is our good marine colonel getting his daily sideburn trim on the morning of day 3 from the civilian that hasn't shaved yet. [Slide.]

Having just gotten his morning sideburn trim, it is time to go salute the boss. Bob also inadvertently managed to get his strawberry drink to leak out here in a big sphere that he was going to have to clean up the same way that Joe showed him the previous day.

This is a whole series of lockers that is on the forward part of the middeck area. Above this would be the flight deck, where the vehicle is flown and operated from. This is the food warmer floating up here against the ceiling. [Slide.]

Vance is sitting up forward. Things sometimes got a little bit busy in the middeck area, with the living, the eating, and the working that was going on there. So he had come up to the flight deck, to the commander's seat, to take some notes and to get prepared for one of the ohms burns that was going on that day.

On his leg here you can see the wireless communications receiver that allowed us to travel around freely, that the Orbiter would then radiate, and this would receive it and then pass it up to his ears and take his comments from his microphone.

In zero gravity they tended to float free sometimes, so he has got a little bit of gray tape here—it was useful for almost everything—just to keep it to his face. [Slide.]

This is Joe Allen with the camera in his hand—it is just outside the field of view here—looking out the window, getting prepared to take one of these beautiful pictures that he has taken.

Right in front of him is what we call a spot meter. It is actually a light meter for sensing the light. It is just floating free. It is not tied down to anything. This is in the aft part of the flight deck. [Slide.]

This is Bob. We would like to deny the observations that in almost every slide of Bob he is either fixing a meal or consuming a meal. Bob was very much interested and worked very hard on our studies of habitability.

Being the first crew of four in the Space Shuttle, or I should say actually in anything, one of the concerns was how do four people get along and live and work in space in an environment that two crewmen really never got to pay any attention to. With two people, we found that on the first four flights, generally speaking, they were always behind and never had time to even catch a second breath. With four of us on board, we were almost never behind so we did have time for one or two people at a given instant to evaluate some of the things that will be necessary as we go further on into the operation area.

Bob here is evaluating some different foot restraints. He is eating a can of fruit cocktail. It is absolutely amazing the way fluids can get managed in zero G. The surface tension takes care of it, and if you are careful, you can eat a bowl of soup with no cover on it with a spoon in zero gravity. If you get a little bit uncareful, though, you have got quite a mess to clean up. [Slide.]

This is just to prove that everything wasn't all fun. This is a medical experiment on the visual acuity. I am probably pretty cross-eyed right now, trying to see how close in I can actually focus on this. [Slide.]

Just to prove that Joe wasn't the only person that operated the cameras, I have a camera here in my hand. I believe this was on day five Joe finally let me touch the camera. He promised in 2 or 3 days I could use some film. [Slide.]

This was Bob with our morning newspaper. The teleprinter came up on this kind of paper, and we would get a little summary of the morning news, it is probably right in here, and then a summary of the anomalies of the Orbiter to date, the implications and so on. It really was a very nominal flight, so that our anomaly list almost was nonexistent each morning. [Slide.]

We didn't always look inside and pay attention to what was going on inside. The Earth is really beautiful. People before us have said that. I personally never had the feeling that I had left it and was off looking back at it. I was still a part of it, a little further away from the surface than I am used to being, but I still felt very much a part of it.

The thing that amazed me was the discontinuity between the places on the ground, that we would look out one minute and be going over South America, glance away for a minute to talk to Joe about something, look back out and I might be over Australia. It was very difficult to keep track, we were moving so fast.

It really is gorgeous. This is a picture of Okinawa. The reason we took it is one of our contingency landing sites, Kadena Air Base, is up in here. [Slide.]

We wanted to with this series here give you a feel for the kind of things you can see if you had your eyeballs and brain in orbit looking out the windows.

This is in the Bahamas area. The State of Florida would be up over in here somewhere. This is the Tongue of the Ocean. It is a very deep bit of water in here. This is shallow, and you are actually seeing here in the lighter blues the sand through the water that is maybe 20 to 50 feet deep. In this area, you can see the various ridges and erosion channels as the silt and things fall off into this deep hole.

This was taken with one camera for sort of a big picture scene. [Slide.]

The next shot then focuses in on the actual channels of the sand that you are looking at here. We are looking through some very clear water because this is maybe 50 feet deep and it looked like it was 2 inches deep. [Slide.]

One of the neat things that you can see from orbit is you can see patterns that extend for miles and miles that you just don't get an opportunity to see on the ground.

Here is a volcanic structure. This is in the northeast part of the Sahara Desert. Here is a volcanic structure, and here is wind erosion channels that go for about 200 miles. If you were on the ground standing here you wouldn't recognize any of this. You would be looking at your local rocks. It is very difficult to put the big picture together unless, of course, you have the ability to get away and look back at it. [Slide.]

I put this one in just for fascination purposes. Here again is some—I am not a geologist, so I would call these rocks or hard geology, basaltic kinds of formations here. Right up against it is a series of sand dunes formed by the winds in a very regular pattern, with cross-currents forming almost like a checkerboard pattern. You see many, many natural patterns like this, more than you would expect. [Slide.]

This is the high Andes in South America, which was very beautiful as we crossed over that. This is the snow that you see up there. The interesting thing is this is their summertime. We were up in our late fall/early winter sort of time frame, so they still have a lot of snow there. You can see a cloud here and you can see the shadow underneath it. Even though the clouds were very, very much lower than we were, we could sense the depth and tell the high clouds from the low clouds while we were going over the top. [Slide.]

This is a little bit further north and west of the previous slide in the volcanic areas. You can see this is a volcano. This is actually the black lava flow in the Bolivia area. There is a whole field of volcanoes here that is not very well understood or known. It probably does manage to, in addition to having volcanoes, contain an awful lot of useful minerals. [Slide.]

This is fascinating. This is very typical of the Amazon watershed in South America over the land. You see the low, scattered stratocumulus clouds that are formed, but it stops abruptly at the shore-

line. This is the Atlantic Ocean out here. You can see some fair weather clouds out there, but the general pattern stops right there. The water is cooler than the land, so that the convection is ceased over the water. [Slide.]

Sunsets are even prettier in orbit than they are on the ground. The Mexican volcano that threw up all the ash that makes the sunsets and the sunrises tend to look red on the ground was even more beautiful on Earth.

In a way I am happy to report but I am also sad to have to say that when we take a picture, we just don't capture one-tenth what the human eye sees. Where you can see, if you try very hard, maybe three bands, we could see six or seven bands in the red and several bands in the blue. It is just absolutely gorgeous.

The Orbiter really held a nice attitude to allow us to see things and to get references. [Slide.]

The next slide is a picture of the Orbiter. We have our nose toward the sun, but pitched up a little bit in order to keep the Sun from coming in the windows. We were in that attitude for many hours, about 20 hours, to study the thermal effects.

But one of the interesting things was that in the middle of that Joe and I looked aft, and we noticed the shadow of the nose, right here on the tail, and these little bright bands here are the Sun coming through the hinge line on the cargo bay doors right here.

We watched that and with our eyeballs we could actually make out individual tiles of the three-by-three or six-by-six dimension. We could watch that for an entire sunside pass of about 1 hour, and that Orbiter held such a beautiful attitude. It just never moved. [Slide.]

Back to living in space, not too much different than being in a motel, or being home, for that matter. This is Vance, our commander, shaving in the morning. Here is a mirror that he is looking in. He has a tissue kit here and various other things that are strewn around. Here is a television camera. I guess we don't have a television in our bathroom at home, and I hope I don't have one in my motel right now. [Laughter.]

This is Vance's clothing locker with his clean clothes to get on for the day. Here are some of the food trays up here. This area tended to get quite busy because it is where we lived and worked.

This is a drink with a straw in it, and this is half of a jalapena pepper that I have yet to finish. Three pencils here are velcroed to the locker wall. [Slide.]

This is Joe and myself getting ready to change some film packs on our Earth-viewing cameras. [Slide.]

Bob, who was our maintenance man in orbit and actually did change some wiring to a cathode ray tube, came down to our maintenance locker here and our tool kit and opened it up and all these hoses jumped out and tried to grab him. It only took Joe and Vance an hour and a half to untangle him. [Slide.]

All was not bad. Sometimes patterns like that could be very useful. We had our water hose here connected to our water dispenser. When we made the meals, we put the containers in here and then operated the automatic features here that would rehydrate the food.

Off the side here we had the other water hose that is coiled here, and then out through a nozzle-like affair where you would squeeze this down to get water. You could take this across the Orbiter and use it to fill up a washcloth or something, turn it loose in the cabin, and it would very slowly, in about 2 or 3 minutes, float back to where it was and coil itself and just sit there. We would like to get one for our garden hoses at home. [Slide.]

Bob was very heavy on the foot restraints. As most people know, I was born and brought up in Miami, Fl. and didn't wear shoes all that often. I thought that the other three of them were operating at a decided disadvantage. They had two hands each and I had the equivalent of four hands.

That is what I am doing here with my bare feet. I tended to go barefoot in orbit, except for two nights it got cool, so I put socks on to sleep. I am holding on to this pipe here with my feet and just moving myself around with my feet. My hands then are totally free to use.

Colonel OVERMYER. I think that might explain, though, why every time Bill did something good we rewarded him with a peanut. [Laughter.] [Slide.]

Dr. LENOIR. This is the Commander sleeping. People ask, how do you sleep in orbit? It was pointed out to us before the flight that we never had gotten a picture of an astronaut actually sleeping in zero gravity. We have pictures of Vance, Bob and myself sleeping. Apparently the night stalker took the pictures. We are not really sure who that was.

This picture was taken of Vance. We were in the flight deck area, and he is heads down, which is just the way he has relaxed, his feet are up, he is floating free, except we have a little tether here that is intended to tether books, so that when you let go of a checklist you don't lose it.

In zero gravity, if you let go of anything for more than a few seconds, it is Murphy's law, it is gone. You may never find it again for days until all of a sudden it will float by or reappear on a filter somewhere. On entry, three things floated by me that we hadn't seen for days.

So, Vance has gotten a tether, hooked it up to a hook on a zipper, and then just tethered himself off to the panel to keep him from going too far.

This body here behind him is me. I am sleeping over in the corner. I just kind of jammed myself off in an area, untethered, but there were enough things around that I didn't have enough freedom to get back out. I had to bend my body to get in, and once I stood up straight or laid out straight I wouldn't float back out.

Joe and Bob slept on the mid-deck area. [Slide.]

The mid-deck area, as I mentioned earlier, tended to get pretty busy. This is on the flight deck again. Forward is in this direction. This is the aft panel, and this is the pilot's ejection seat.

This was a very nice place to come and work. I put my bare feet and hung on to a thing under the seat here. I put my back up against this panel, put my food tray between my knees, and I ate up here on the flight deck.

This is a grapefruit drink that looks like it is tied down, but it is not. It is just floating there temporarily. [Slide.]

At one point Joe had changed clothes and he left his flight suit out. It really gives you kind of an eerie, headless horseman kind of an appearance here. If you set that down on zero gravity on the floor or the desk or wherever, it would get all crumpled up, but in zero gravity just a little bit of texture to the material makes it fold itself out and take its full form again. [Slide.]

This was the day we were getting ready for the EVA. As I am sure you know, we do most of our training for the space walk in a water tank, where we hang lead weights on us to make us neutrally buoyant.

We had every now and then, the divers that keep us safe would sneak a rubber shark in and we would see a fish when we were in a water tank. We were quite surprised to discover that it wasn't much different in zero gravity, that we had our friend here that had come up with us. I sure do seem to be giving him a weird look, don't I? [Slide.]

This was a picture of inside the cargo bay after we had closed the doors. The surface of the radiators are very highly reflective, as Bob mentioned, so just a little bit of light by reflection will light the whole cargo bay.

This is getting ready to come home. The SBS sun shield is open and so is Telesat's sun shield open, so that we could close the cargo bay doors. They are not quite closed yet, but they are getting close. [Slide.]

This is a still picture that Joe took with a camera that he held in his hands of the glow out the forward windows that we saw in the movie. I might point out that at the time we took this it is pitch black outside. That is the sheath that causes the communications blackout during the entry. [Slide.]

This was our grand finale. We had called our selves the Ace Moving Company. We had developed the motto "We Deliver". This was later on in the mission. We got the four of us together in our spoke fashion where everybody is off in a different attitude. Except for Vance, who has got the writing that might claim he is right side up, we all felt we were right side up, so that we got in here.

I ought to tell you a little bit about how we took the picture, which would explain some of the pained look on Joe's face. We had a 10-second timer on the camera. Joe set it, got it all set up behind the camera, and then as soon as he got it set and released I grabbed him by the hair and pulled him over here to get him in the picture.

Getting him there was no problem, but in zero gravity there is no drag or anything, so you get him moving, now you have to stop him. I got him there, but then we had to stop him and get him squared away and oriented.

We took three pictures and this was the best one. As a matter of fact, on the first one I think I still have my hand on his hair. [Slide.]

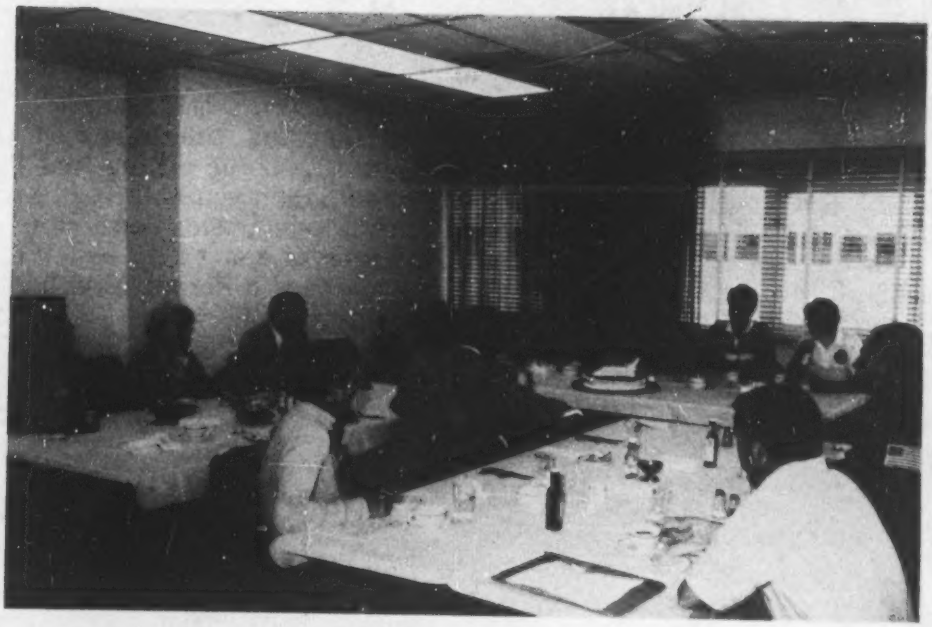
This is Vance with the garbage. Vance actually posed for this and made us take this picture on the second day to prove that the Commander indeed does get out and work with his men and takes his turn taking out the garbage.

Commander BRAND. We had a democratic crew. [Laughter]

Dr. LENOIR. Vance made us take this picture. It is curious, but I believe it was the last time that Vance got that close to the garbage. [Slide.]

Here is another shot of us living and working in space. We tended to be in a bunch of attitudes, as you can see here. One of the reasons I tended to be upside down more than the others was being barefoot, there were some light tethers on the ceiling that I could grab and hold on to with my feet, but when you had socks on they just didn't work that well. So I tended to be upside down more than the others, and it was generally a way of doing business. We came down there and everybody was pointed a different way, but in zero gravity it is very comfortable and you really enjoy it.

[Slides 1–42 refered to above in the oral presentation follow:]



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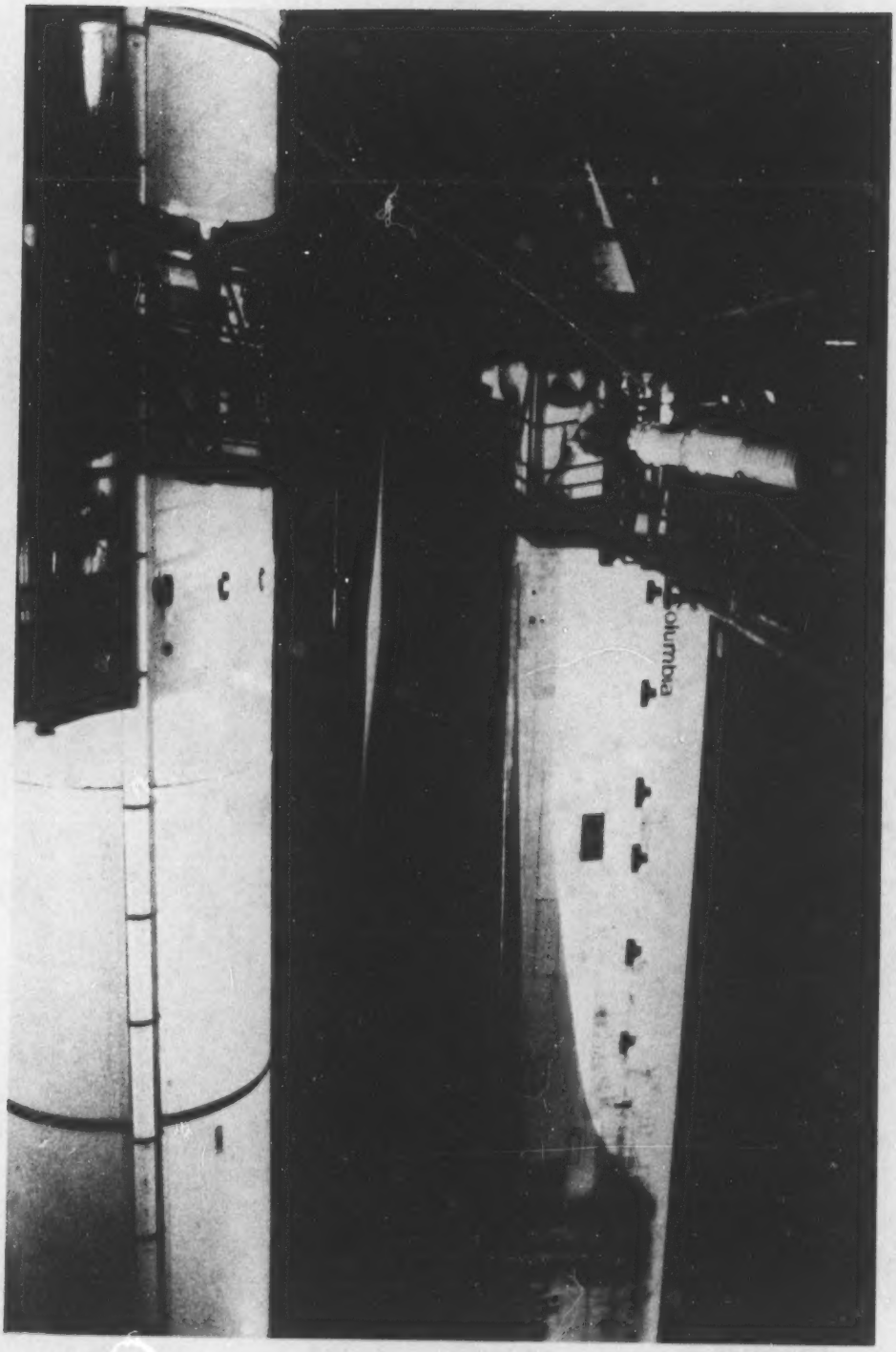

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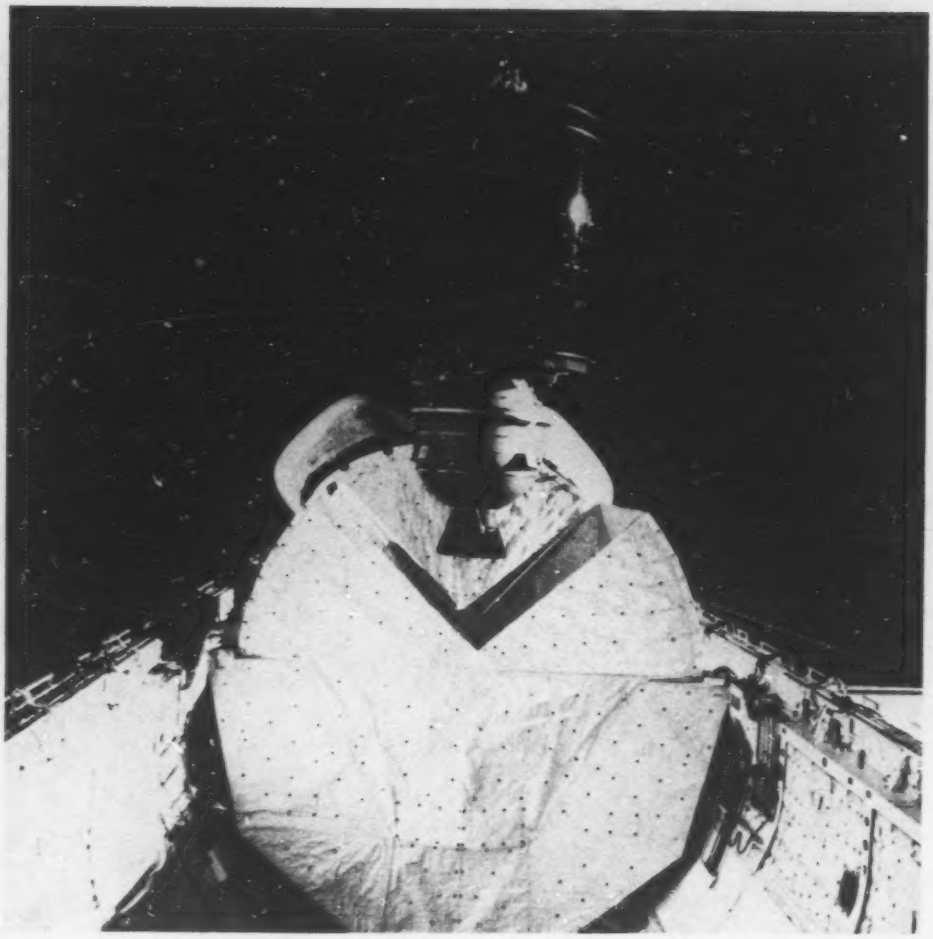

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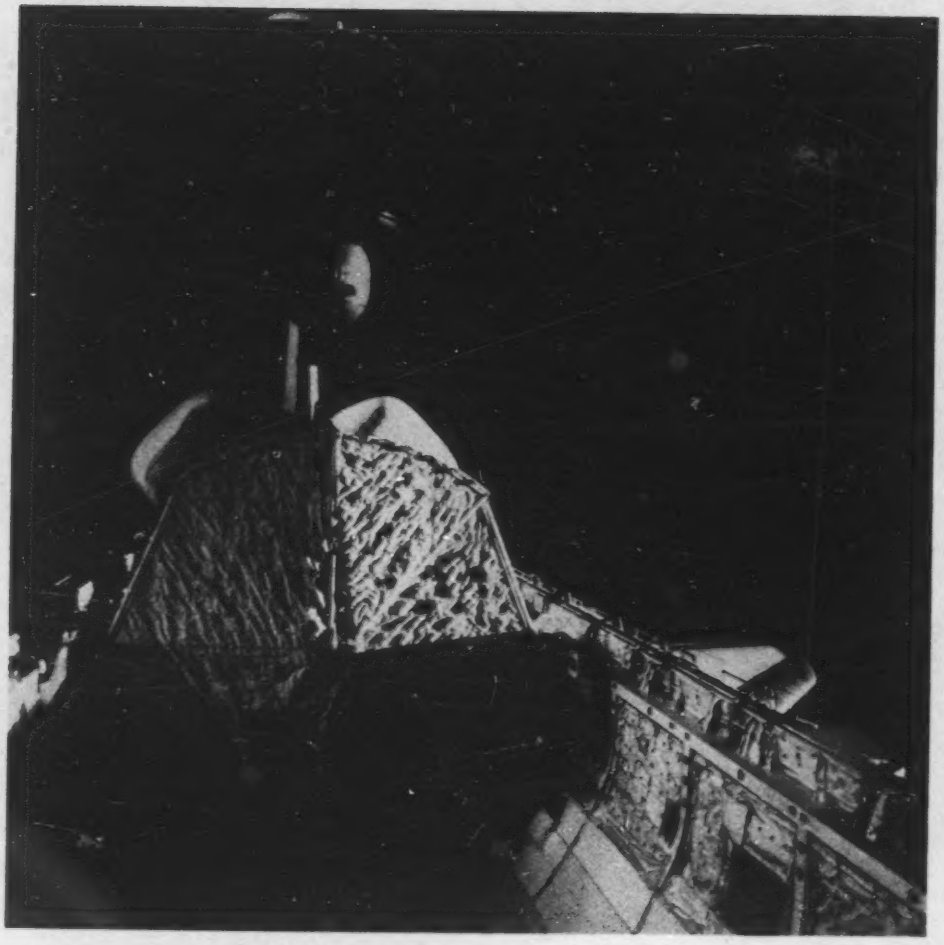

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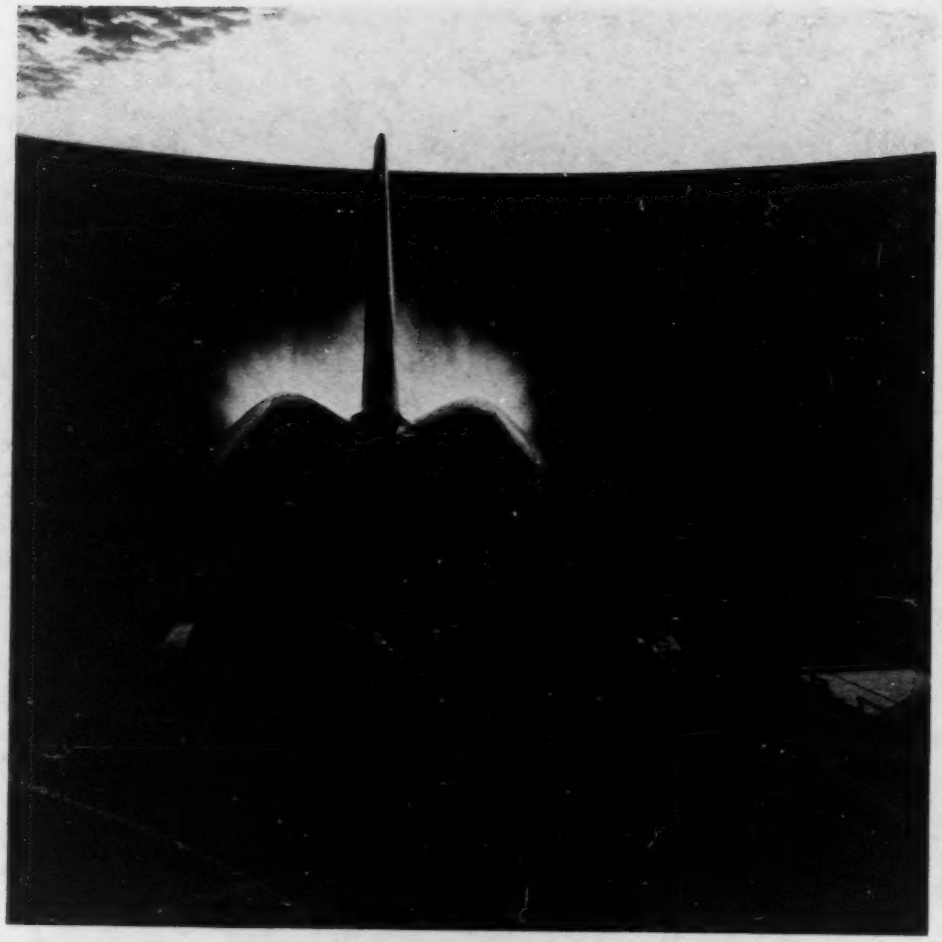

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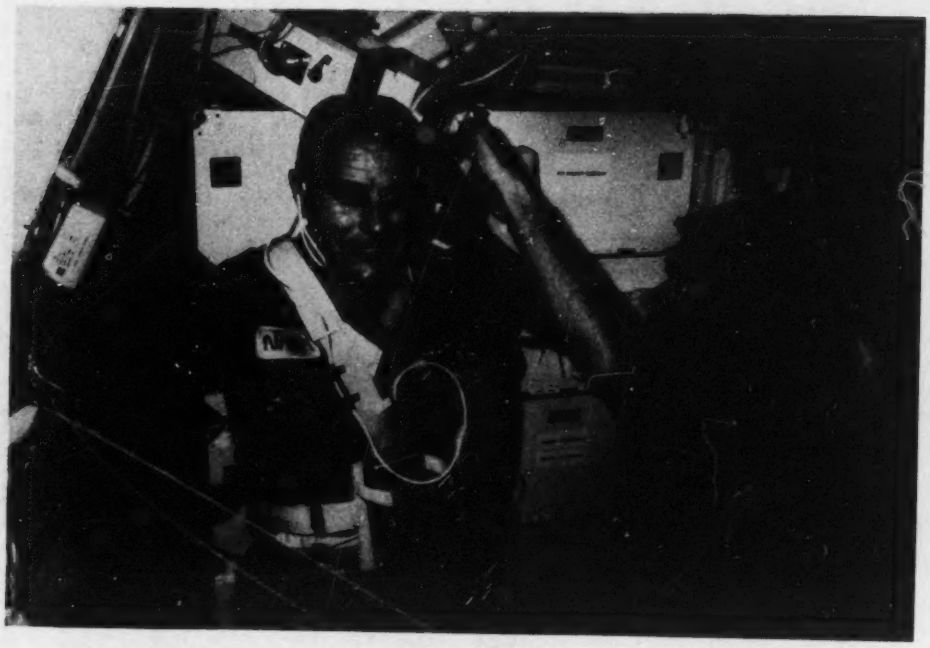

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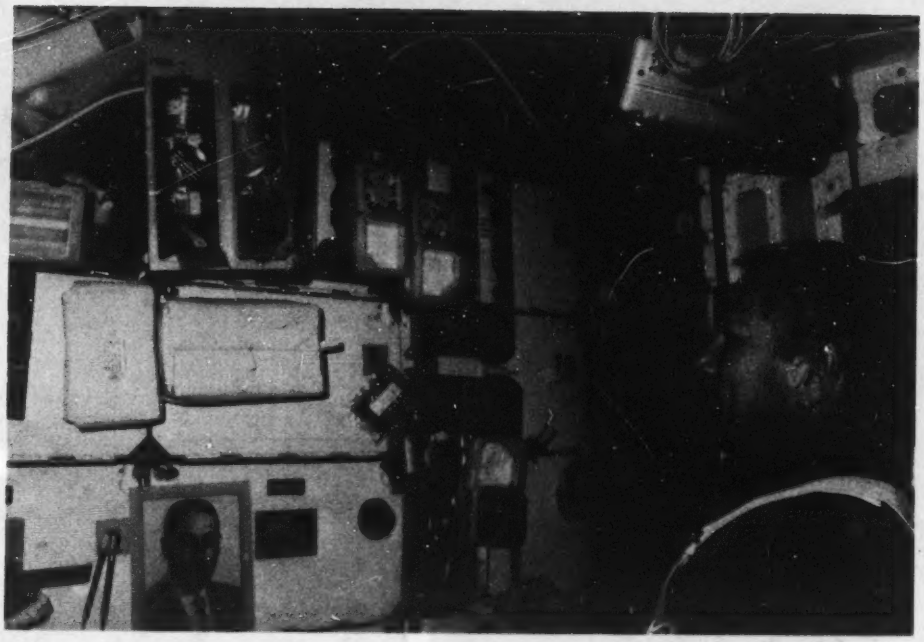

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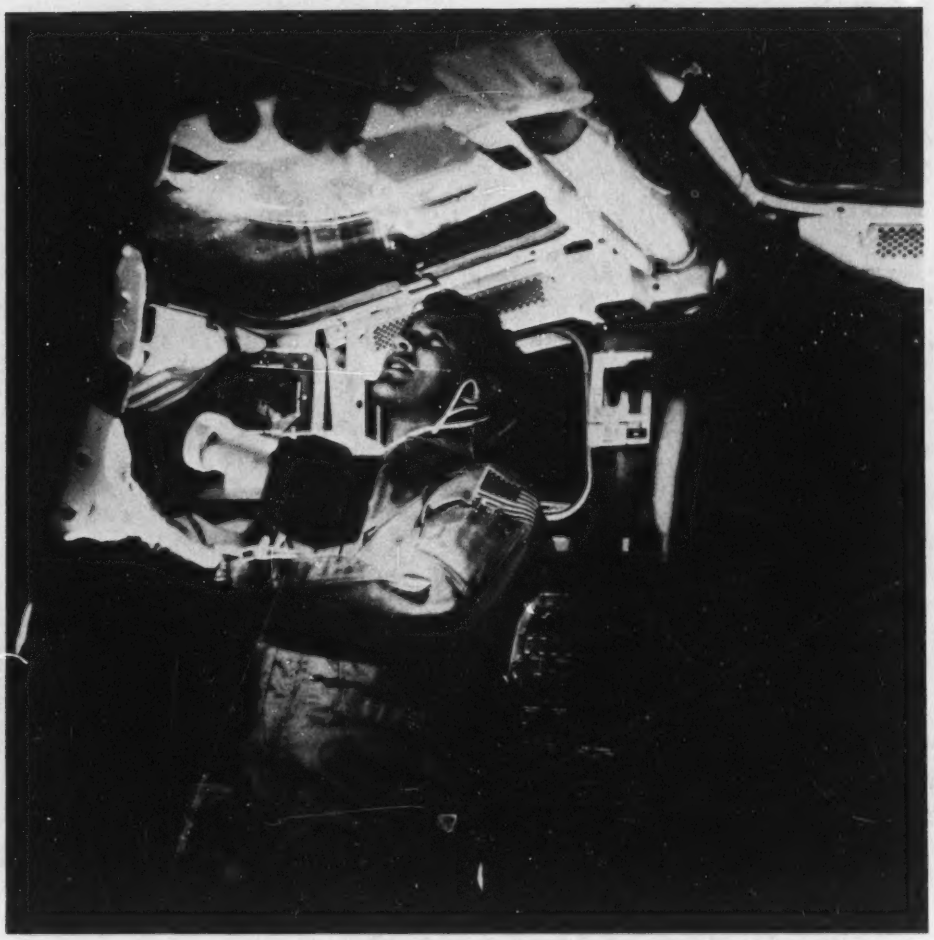

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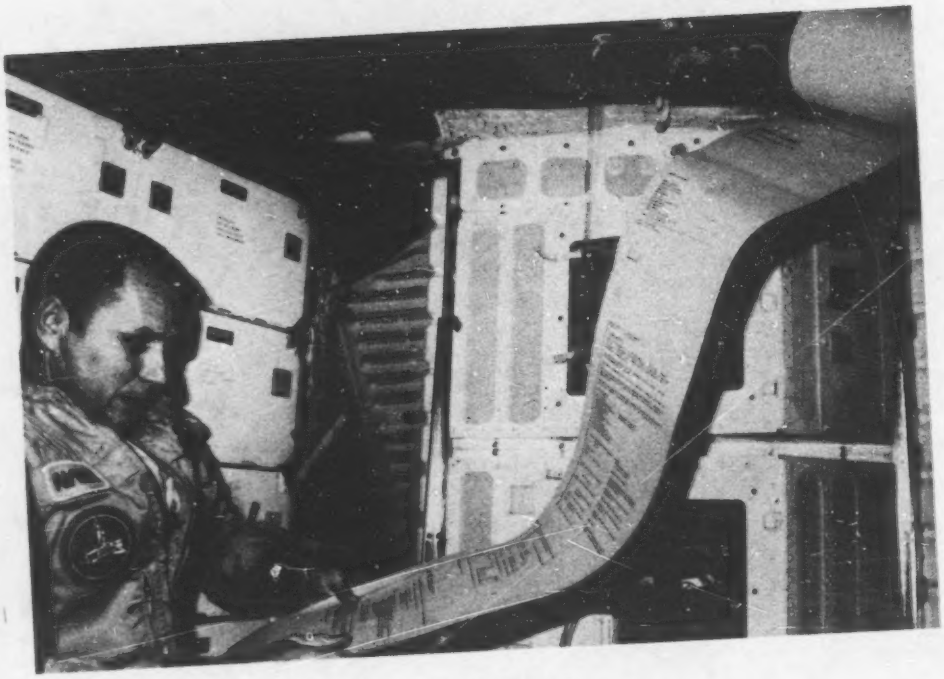

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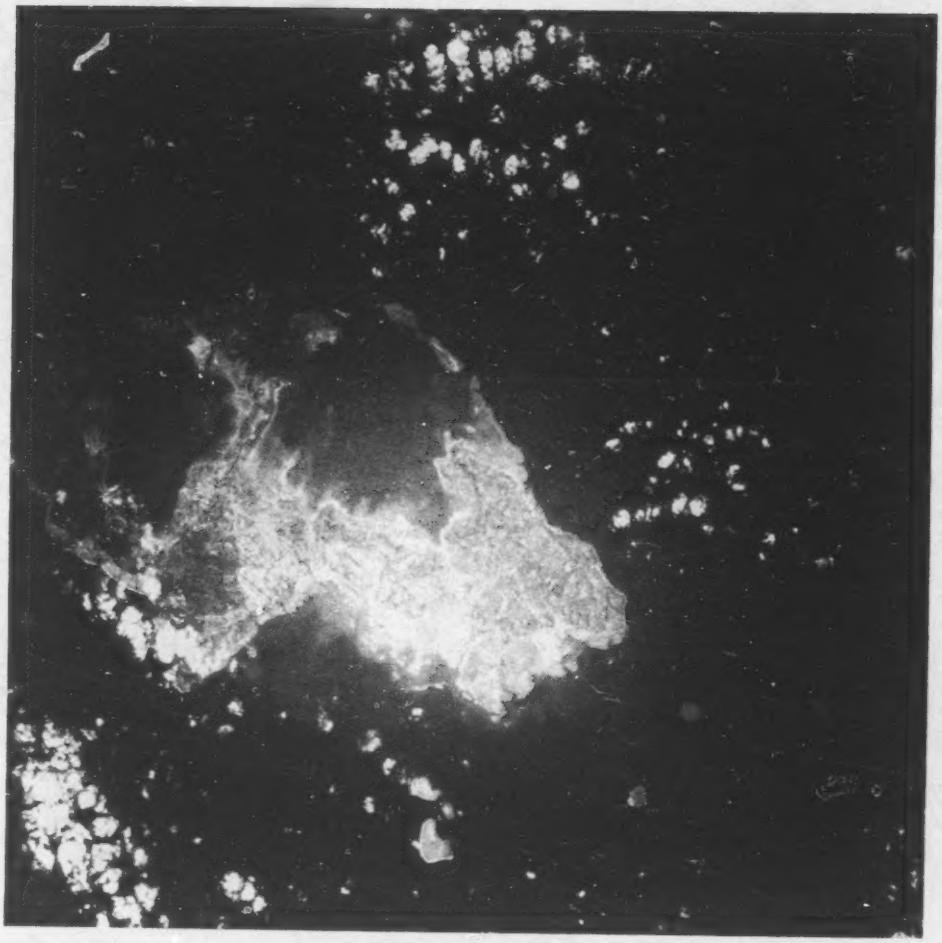

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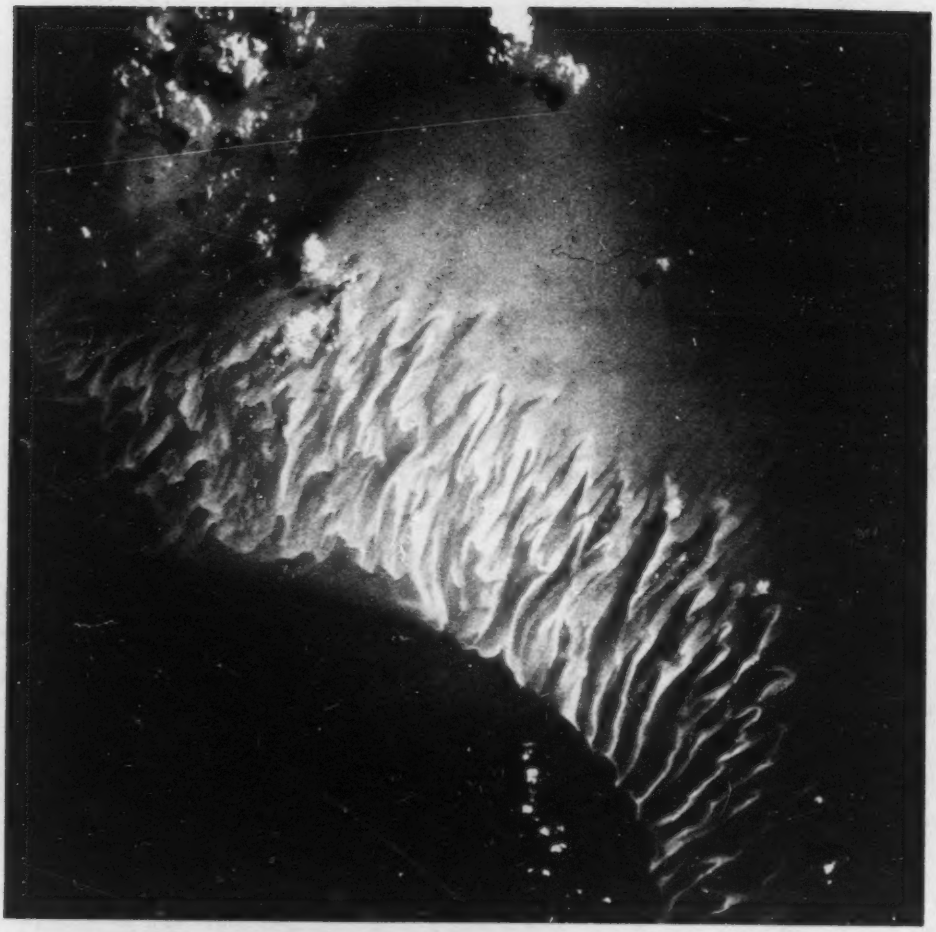

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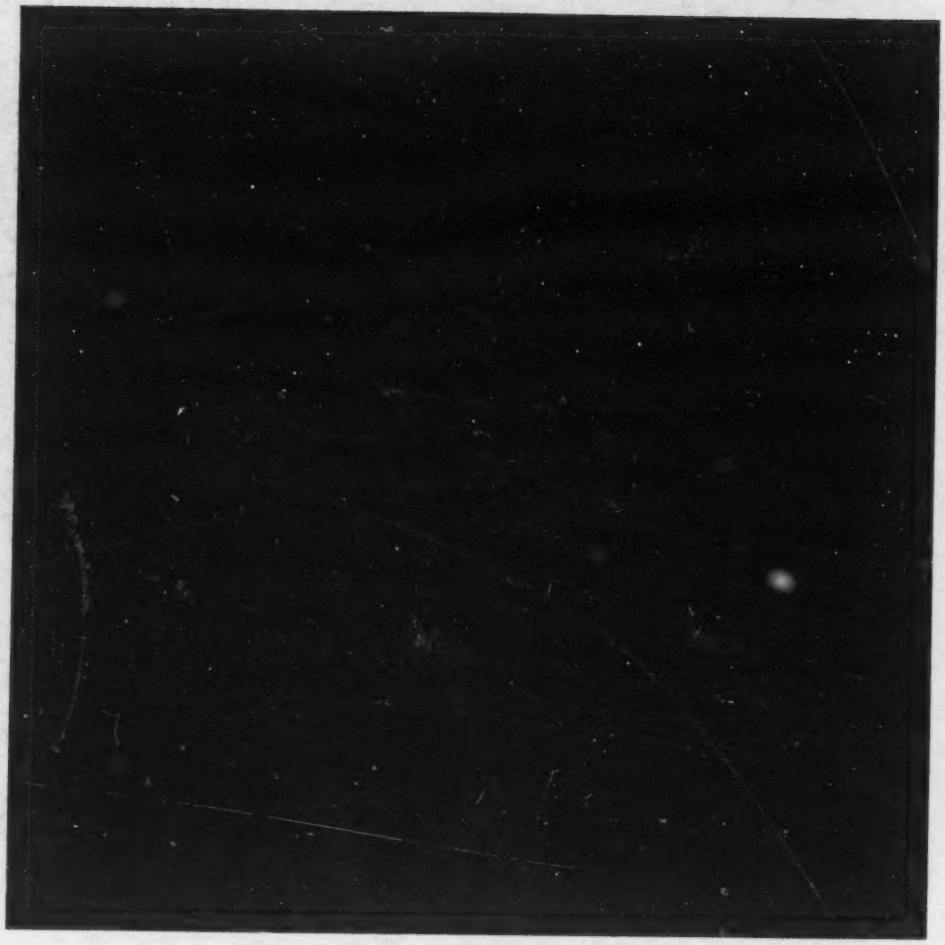

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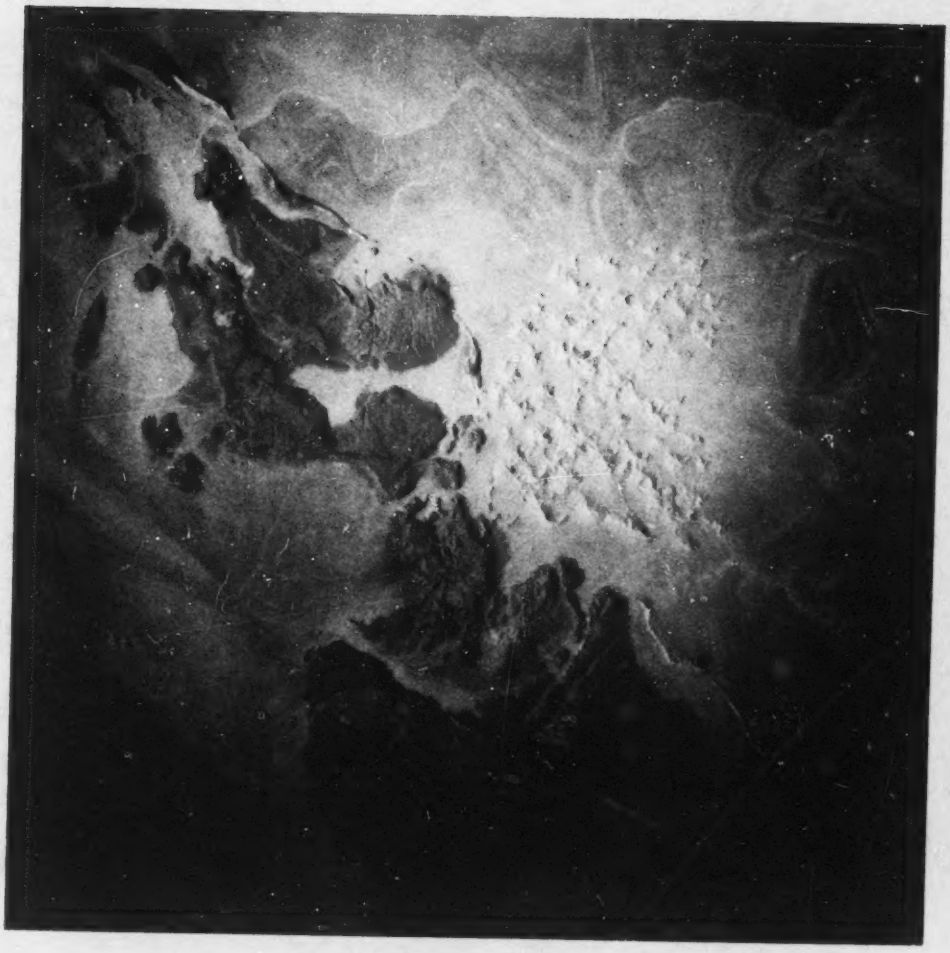

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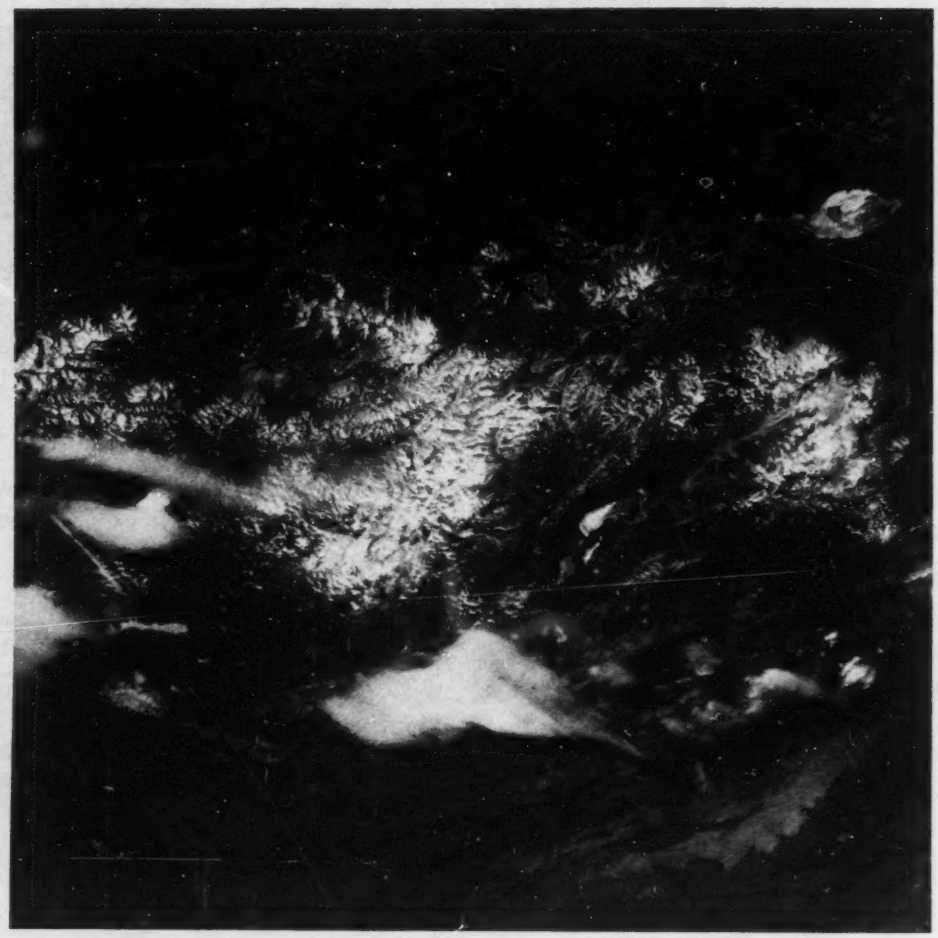

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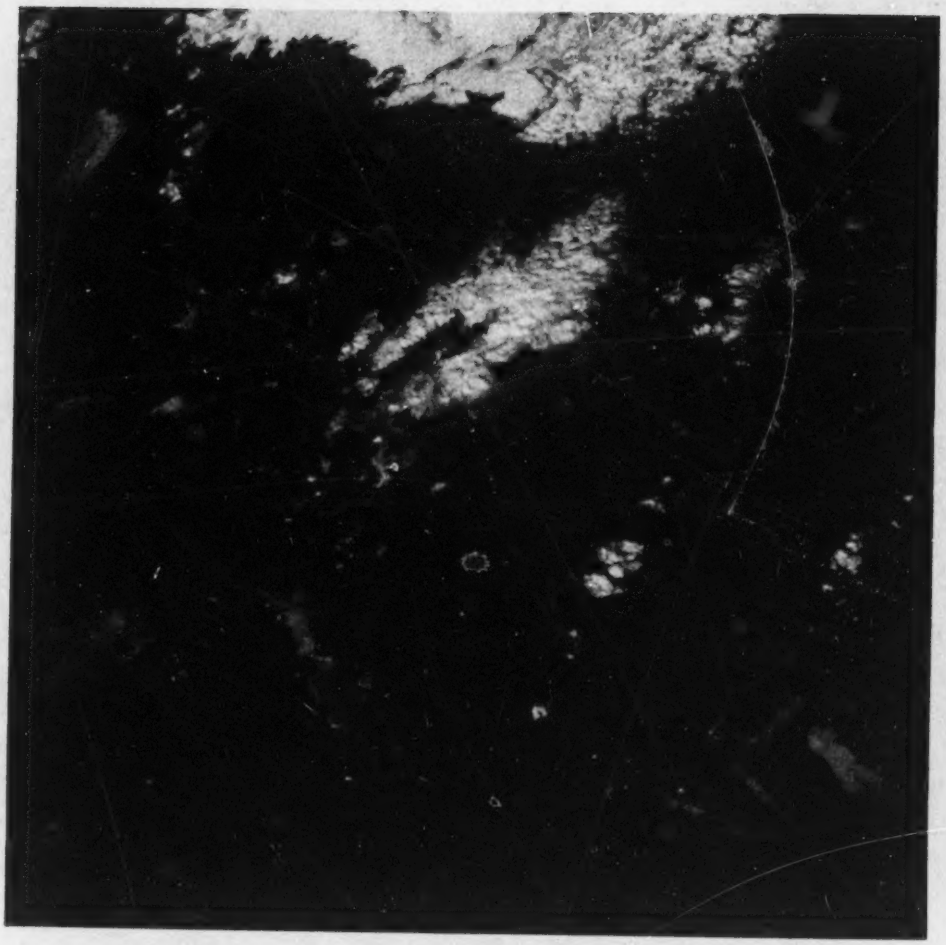

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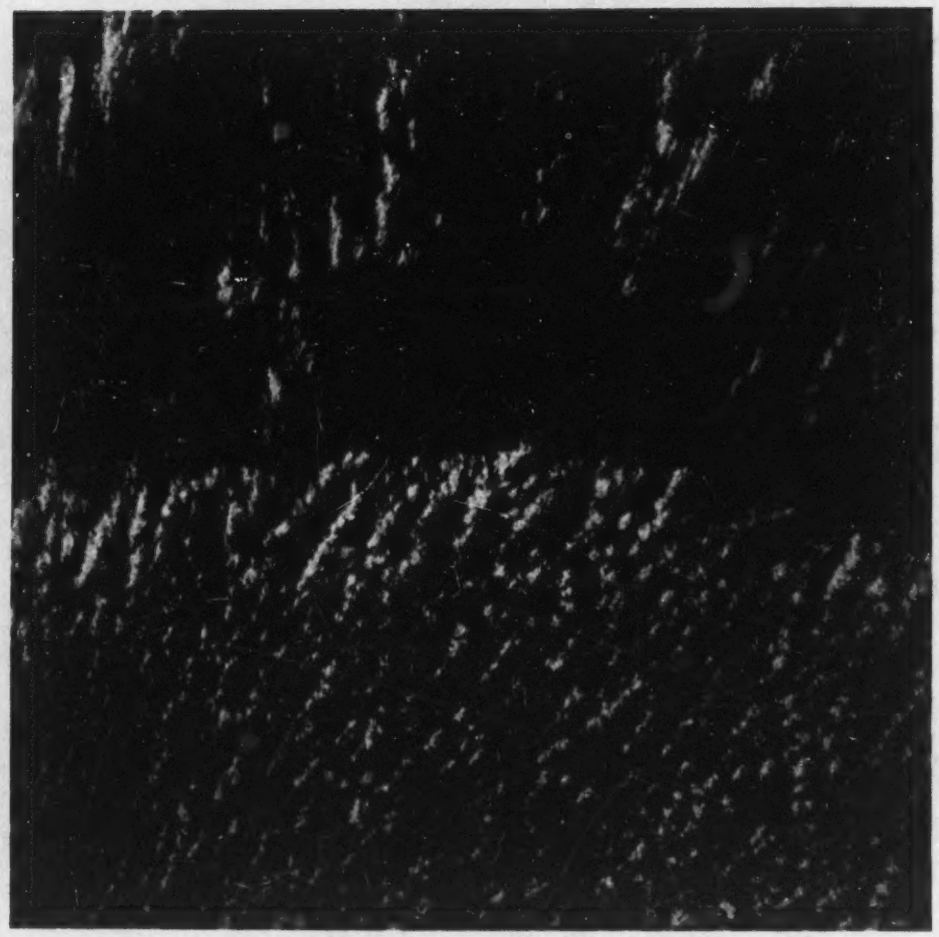

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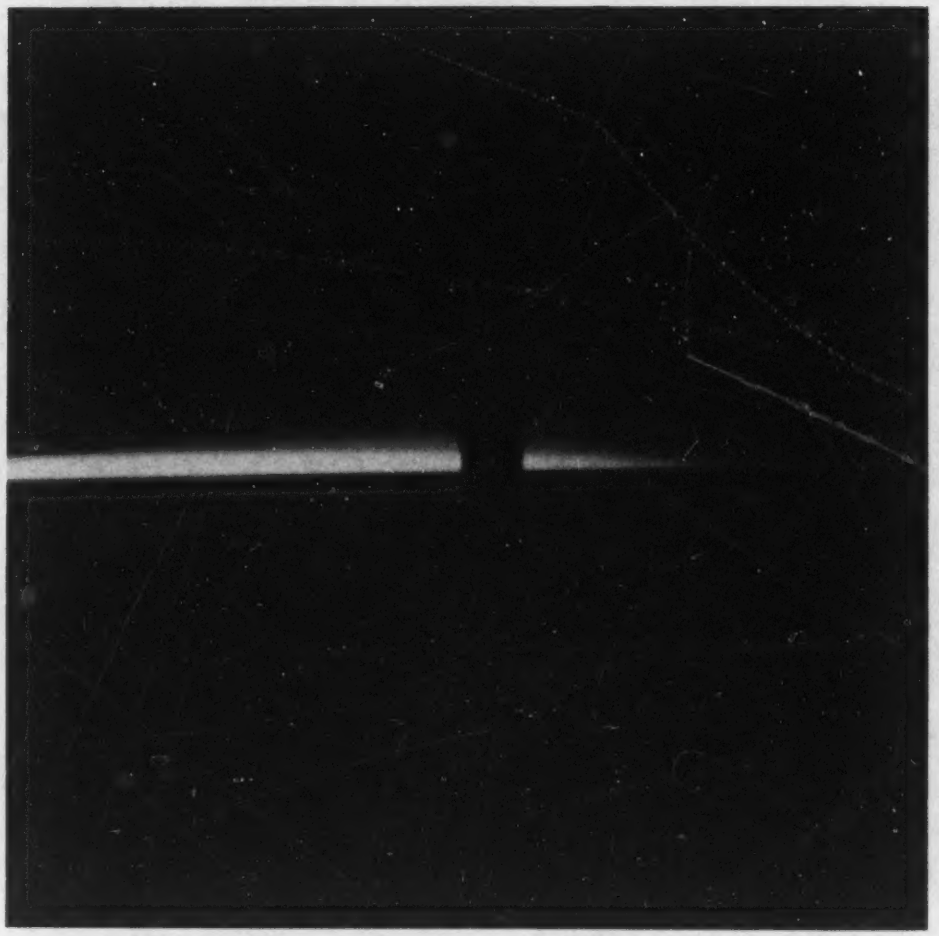

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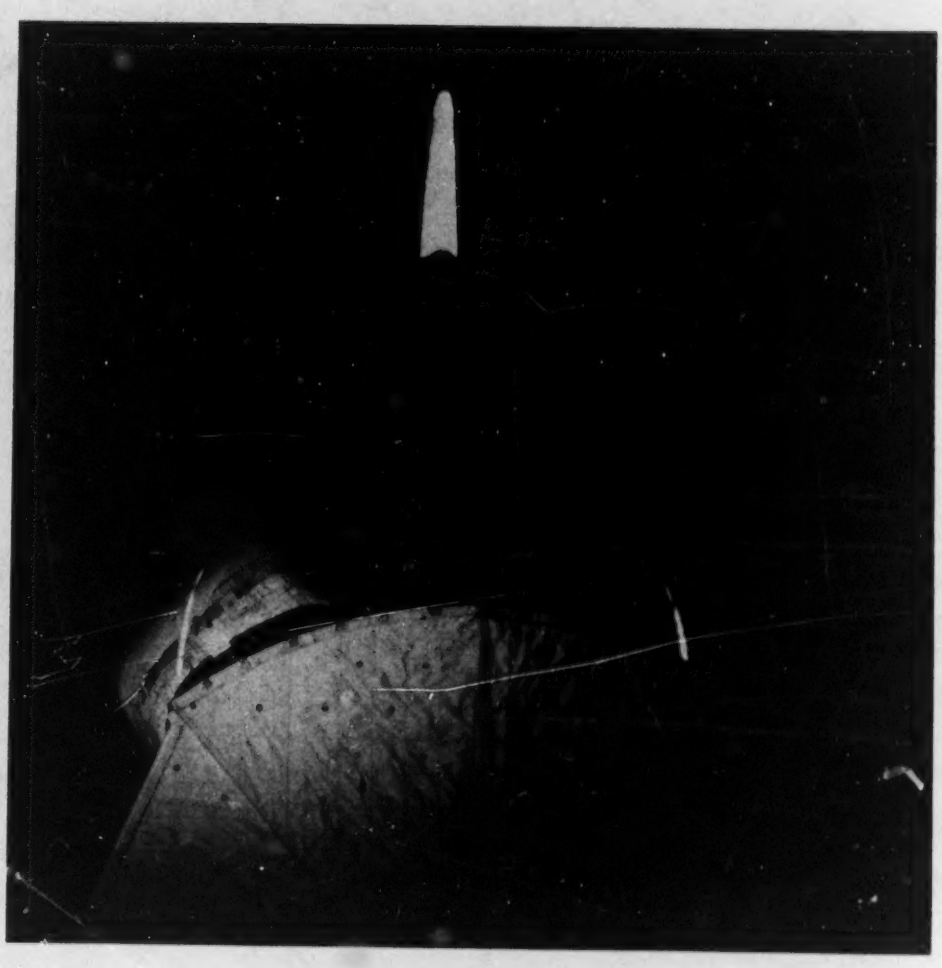

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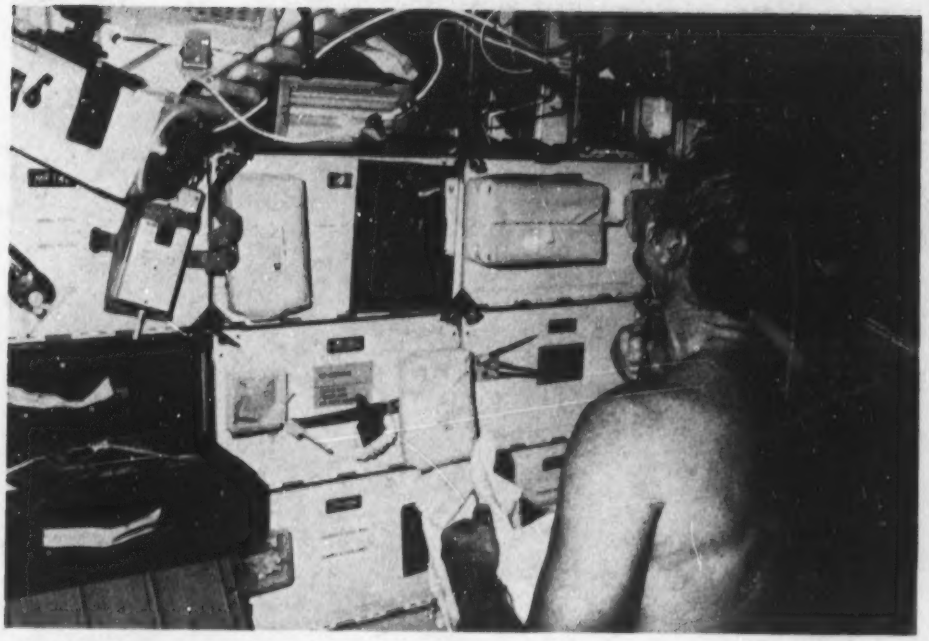

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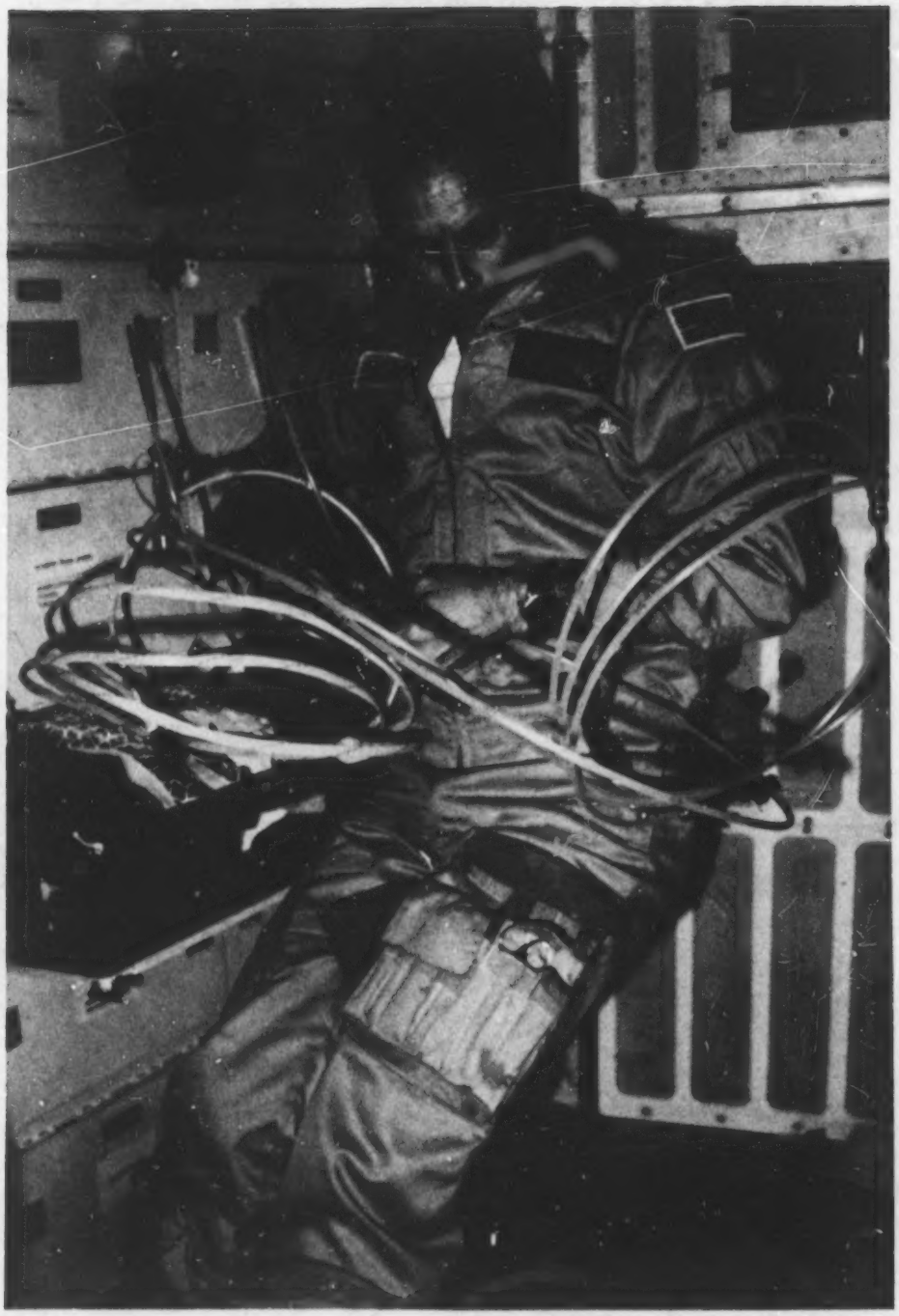

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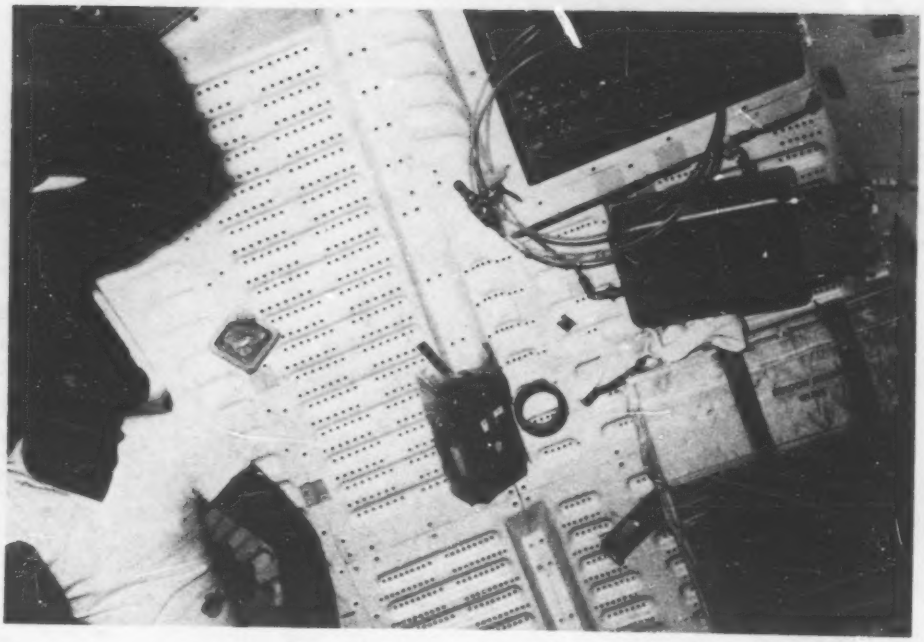

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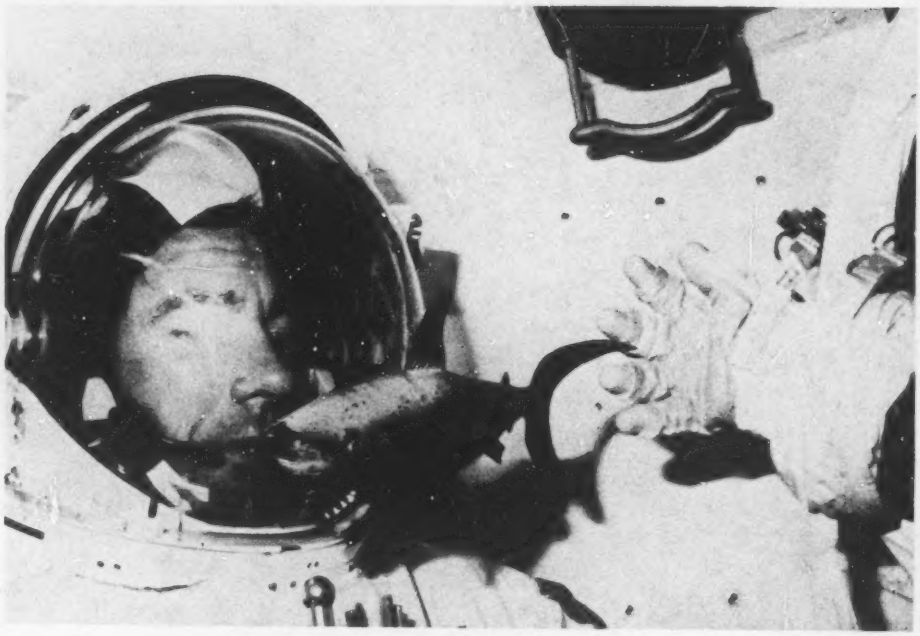

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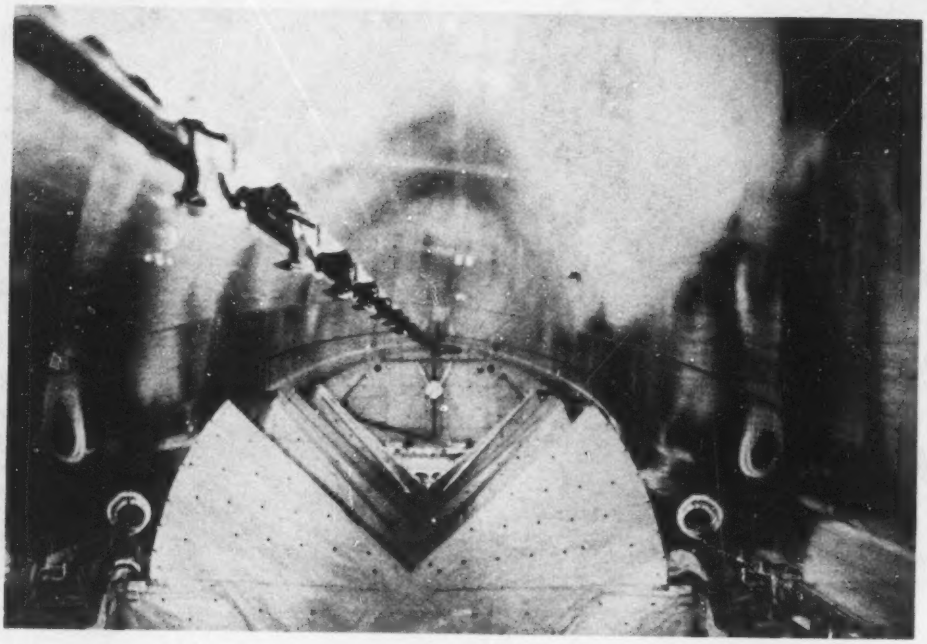

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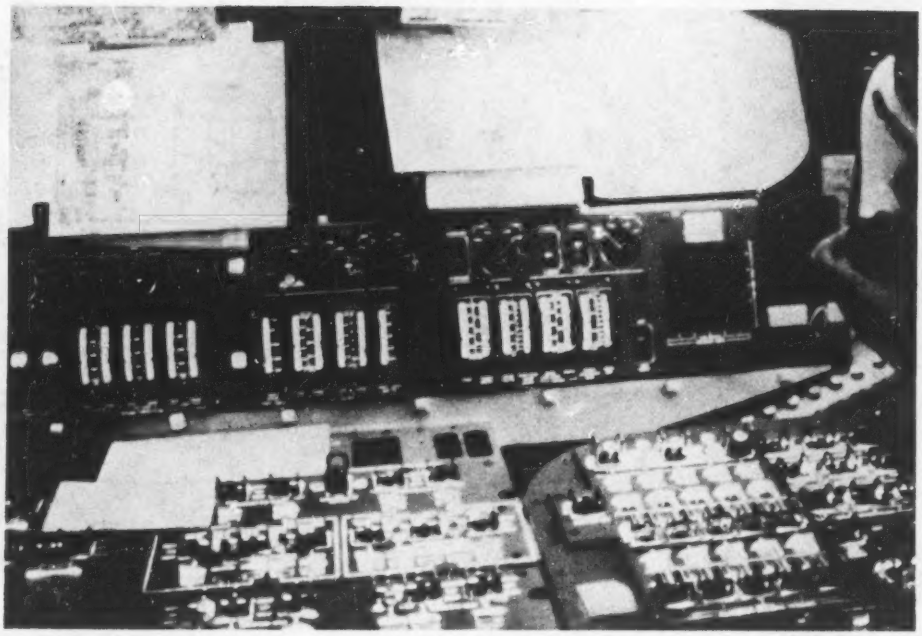

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SLIDE No. 42

Commander BRAND. Just to finish off, Bob, Bill and then Joe have a very quick summary.

Colonel OVERMYER. Mr. Chairman, as the pilot of the STS-5, my duties were primarily associated with the operation of Columbia, the Columbia systems, and getting a chance to fly it whenever Vance would let me have the stick. I would like to report to you that Columbia performed almost flawlessly. It is obviously a mature system now, it is ready to do its job, and even though it has a few million miles on it already, it is obviously good for another 95 flights, as we really have planned for it.

It is getting a little bit of a rest now down at the Cape, as we get it ready with the SpaceLab mission for late September, but I am confident that Columbia is going to perform. I am also confident that Challenger is going to take up the slack here and perform as well or better than Columbia.

I would also like to report, in looking so long as we did at the habitability, that we feel confident that a five-man crew in Columbia right now with its present configuration with the ejection seats would be absolutely no problem.

John, on SpaceLab flight, with the extra living accommodations, should have absolutely no problem with the six-man crew. We think that with Challenger, with the extra room that Challenger has, represented by the ejection seats being out, should very easily take a six-man crew and maybe even more.

So, it looks to us, sir, like the Columbia has performed flawlessly, and as a man primarily concerned with its systems, we had no problems with it. It was just a superb spacecraft to fly.

Dr. LENOIR. Thank you.

I just have a few things to add. I got most of my comments in during the slides.

The couple things I would like to mention or amplify on that Vance or General Abrahamson mentioned earlier, the space walk that Joe and I were to do on the 5th day was a personal disappointment to the two of us, that we would have really enjoyed doing that, and we were trained and really keyed up for it. But to the program, I don't think it is a major item at all. I think it is just a very minor setback. We are going to take a look at that again on the next flight, and in 6 months or a year from now we are going to be further ahead because of the way that we did that on our flight.

We went up to test all that, and test it we did. We found it a little bit short of what we wanted. We have learned sooner than we would have otherwise, and we are in the process of fixing all that, some of it having already been fixed.

There was some big flail in the press on how we had adapted to weightlessness. We were a little bit taken back by it when we found out the magnitude that it had all stirred up once we got back.

One of the things that we didn't give you a feel for in the slides is that when you are in orbit you get about 5 minutes every now and then that you can talk to the ground. By the time they call you and tell you, "Columbia, this is Houston," and you exchange all of your pleasantries, that is down to 4. Usually you have some things to say or you are too busy to talk right then, so out of every

half an hour or so you get 5 minutes of communications. So you don't really have the potential or the possibility to keep a running dialog and keep in real close touch with the pulse on the ground or in orbit. I think that probably created some of the problems there.

Our analysis and our experience indicates that we really didn't feel very bad at all. The feeling that I had was more toward a feeling of being out of sorts for a short period of time, for about a half a day. I could have done anything. We, in fact, missed none of our objectives, missed none of our operations because of that.

I could have done anything at any time, as I think we all felt, although for a short period of time, all other things being equal, if I didn't have anything to do I would just as soon take a short nap. That is the way it worked out.

I think we have learned a lot about how we adapt to a weightless environment. I think we do have some more to learn, but I think we ought not go and overestimate its importance or the way it will constrain our operations.

My analysis, looking back on it, is that we are fairly safe if we would assume that everybody in the future is going to adapt to weightlessness in one way or another and it won't affect our operations at all. Go ahead and plan around it as though it didn't even exist. Especially with crews of four and more, I think it will not affect our operations at all, and that includes space walks.

Looking a little bit further ahead, and not very much, as Paul Weiss could tell you, we ought to start looking past STS-5—that is us—and looking toward STS-6. That is the big game in town right now.

They have some real challenges ahead of them, not the least of which is Challenger itself, which is a new spacecraft, so that that is an order of magnitude a different level of problems than we had. We had, as Vance and Bob have mentioned, a used spacecraft to fly, which to me is very comforting. The bugs are out of it. The little things that got us on little bits and pieces of flights 1, 2, 3 and 4 were taken care of.

We have a new vehicle to look at on flight 6. In addition, they will be looking at the inertial upper stage. We had the payload assist module that was the first for us. They will be looking at and hopefully proving operational the other upper stage that is in our arsenal.

In addition, to help with what I mentioned with the communications gap problem that we had, on their inertial upper stage they will be launching a tracking and data relay satellite that will greatly increase our capability of talking to the ground almost full time.

With the launching of the second one on the eighth flight, then we will be almost to 100-percent communications coverage, which ought to make it a lot easier for both the ground and orbiting spacecraft and crew to keep their finger on each other's pulse.

Last and certainly not least, the sixth flight will be doing the space walk that Joe and I were scheduled to do. We think at this point we do have the suit problems figured out. We have changed the way we do business. We have changed some of the hardware, and we think that they will be doing the walk. I would like to think of our flight and this era, really, our flight, flights 6, 7, 8,

and so on, not as the end or not even as a beginning but more as the middle. If Apollo XVII was the end of the beginning, we now have an operational Shuttle.

That is kind of the beginning or the middle of the middle part of the space program as I see it from my professional lifetime and would like to think that we should start looking ahead as to we have a tremendous capability here for deployments, and what else are we going to use it for and where will we be 5 or 10 years from now?

Finally, to amplify one of the things that Vance said, we four have gotten an awful lot of publicity, as you well know, probably more so than most. We were just the visible part of a tremendous iceberg that includes an awful lot of people, both at the Johnson Space Center, within NASA as a whole, and the country as a whole.

We really feel that we are four fairly little people that have stood on the shoulders of giants, the citizens of the United States, who have so faithfully supported the program and given us the mechanism to help and to pull us as far ahead as we feel that we have gotten.

Thank you.

Dr. ALLEN. Mr. Chairman, I, too, am very honored to appear before you this morning. I have a few remarks that I would like to make.

First, a few years ago I had the good fortune of working directly with your committee. I can genuinely say that I feel a lot like I have returned home for a visit.

I do not want to state that extended Hill experience is better than a simulator or the best preparation for going into space, but I can tell you from very personal experience that being an astronaut is considerably less taxing and probably also less dangerous than working in the political arena. [Laughter.]

My wife and I were here about 5 years ago, and we enjoyed returning. Because of that 5-year period, we were thinking back not just 5 years but 10 years ago and realized just in the last few days that right now we should be celebrating the 10 anniversary of Apollo XVII, America's last journey to the Moon. Apollo XVII was flying right now. In fact, they were just in the middle of that journey. That was 10 years ago. With that thought, this morning I went over to the NASA library and pulled out a hearing record from about 10 years ago, thinking that, I wonder what was in the minds of the committee 10 years ago during, really, the height of Apollo?

I had just a few minutes to do this. I thought my goodness, a thick book like this, it will be difficult to find. I opened it to really the first page. To my surprise—maybe not so much to my surprise—I find that on the first page of a hearing before your committee Mr. Teague was welcoming Mr. Myers of NASA.

He was saying that—and I will quote Mr. Teague on this—"I would like to say to you, Mr. Myers, and NASA management, that I am convinced that this is a crucially important year for NASA, and for the space program. I am sure you share with all of us on the committee the concern that we follow through on Apollo and Skylab, but most importantly also the Space Shuttle. I am confi-

dent that you will provide the leadership necessary to accomplish these major flight programs."

This was 10 years ago. The record does not show whether Mr. Teague picked up his walking cane and shook it at Dale Myers. I suspect that tone was in his voice. Had I been sitting next to him, I expect also he would have turned and whacked me with that walking stick. [Laughter.]

He was a man of great vision, and for that reason I am particularly pleased, together with my three colleagues, to report to you that on November 11 of this year, 160 miles above the equator, at a point a little over 1,000 miles west of the Galapogas Islands, the four of us deployed the first satellite into orbit from the Space Shuttle. It lifted out slowly and started on the next phase of its journey to the geosynchronous orbit, where it is today and working today.

We can report to you that the vision of this committee 10 and more years ago became a reality on that day. We the crew, we NASA, and you the committee delivered an operational space transportation system (STS) to this Nation.

Thank you.

Commander BRAND. I believe that completes our remarks, Mr. Chairman. We would be happy to respond to questions.

The CHAIRMAN. Thank you very much, Vance, Bob, Joe, and Bill. We are very grateful for your dedication and hard work and the success of the mission. I think as, Joe, you very ably put it, that is what we were told.

I remember Larry Winn and I—I think we are probably the only two here—sitting in a motel room in Los Angeles when people were explaining to us how this thing was going to work. There were a lot of different configurations. The final configuration had never been resolved at that time, and it was one of the things that we were reminded of, was that it could deploy satellites.

Even the fact that this one was deployed in such a precise orbit, probably one of the best that has ever been delivered, both of them, that it increases the life expectancy of those satellites considerably from their projected life. So it is already paying off.

We have a vote. Unless the members quickly have a question? Mr. Winn?

Mr. WINN. I have just one question.

First, I want to congratulate Joe and whoever else took some of the other pictures. Those were great pictures.

I was a little surprised that you said there was no vibration when the satellites were released. You felt nothing in the Shuttle at all?

Dr. LENOIR. I said that wrong. We actually felt quite a bang. It radiated through the Shuttle structure. One of the pictures that we have on film shows a slight moving of a camera that we hadn't nailed down tight. What I meant by no vibration was watching the spacecraft itself that was being deployed, it obviously did not see that shock because there was no movement at all in it. It is quite a jolt that goes through the Orbiter, just one instant at a time, and we really feel that.

Mr. WINN. I thought there was. You could feel it on both of them? Was the shock about the same on both deployments?

Dr. LENOIR. It was about the same on both. The interesting thing was on the first one we didn't really anticipate it, so it surprised us. I looked very carefully on the second one, to see what it did to the spacecraft, and noticed that it did nothing.

Mr. WINN. Great.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Winn.

Thank you all very much. We look forward to seeing you this evening.

Commander BRAND. Yes, sir. Thank you for inviting us.

The CHAIRMAN. The meeting is adjourned.

[Whereupon, at 12:05 p.m. the committee adjourned.]

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